Nest Population Size and Potential Production of Geese and Spectacled Eiders on the Yukon-Kuskokwim Delta, Alaska, 1985-2012

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ABSTRACT: Nest surveys on Alaska's Yukon-Kuskokwim Delta provide annual information on phenology, egg production, nesting effort, habitat use, and predation for waterfowl, cranes, loons, gulls, and terns. In 2012, atypically cold May temperatures delayed snowmelt and breakup of lakes, ponds, sloughs and rivers. In response, waterfowl nest initiation and hatch occurred six to ten days later than long-term means (1982-2012). Despite late nesting initiation in 2012, average timing of waterfowl nesting has advanced seven days since standardized plot data collection began in the 1980s. In 2012, the number of spectacled eider nests was the highest estimate since 1987. The proportion of active nests (an index to nest success) indicated that nest success was good and clutch size was moderate relative to long-term means. Numbers of spectacled eider nests have increased significantly during the most recent decade, and the population is stable over the 28-year span of this survey (1985-2012). Geese (cackling Canada, emperor, and white-fronted) exhibited moderate or high production of nests and eggs, and good to excellent nest success; yet clutch size was very low relative to long-term means. For cackling Canada geese, emperor geese, and white-fronted geese, numbers of nests have increased significantly over the long-term (1985-2012) and short-term (2003-2012) periods.

The Spectacled Eider Recovery Team identified annual nest surveys as the primary method to assess of population status relative to recovery criteria for the Yukon-Kuskokwim Delta (YKD) subpopulation. Based on these nest surveys, the Yukon-Kuskokwim Delta subpopulation of spectacled eider is close to the benchmark criteria for consideration of

delisting from the Endangered Species Act. The current Spectacled Eider Recovery Plan, however, calls for growth in the North Slope population prior to delisting any subpopulation from Threatened status. We recommend the Spectacled Eider Recovery Team review reclassification criteria in the Spectacled Eider Recovery Plan to determine if analytical techniques should be updated with contemporary methods.

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INTRODUCTION

Two decades of declining populations of goose and brant that nest on the Yukon-Kuskokwim Delta caused conservation concern (Raveling 1984) and prompted studies to determine whether poor production by nesting birds might be contributing to declines. Annual nesting surveys on the YKD provide information on nest population size, egg production, phenology, habitat use, and predation for a suite of waterbirds including cackling Canada geese (*Branta canadensis minima*), emperor geese (*Chen canagica*), greater white-fronted geese (*Anser albifrons frontalis*), tundra swans (*Cygnus columbianus*), sandhill cranes (*Grus canadensis*), spectacled eider (*Somateria fischeri*), common eider (*S. mollissima*), Pacific loons (*Gavia pacifica*), red-throated loons (*G. stellata*), glaucous gulls (*Larus hyperboreus*), mew gulls (*L. canus*), Sabine's gulls (*Xema sabini*), and Arctic terns (*Sterna paradisaea*). Biologists and managers use these long-term data sets to document baseline inventory of wildlife resources, implement cooperative waterbird management plans (e.g. goose management plans), assess waterbird distribution across the YKD landscape, develop habitat association models and vulnerability assessments, and characterize inter-specific relationships.

In response to a dramatic decline in abundance in western Alaska (Stehn et al. 1993), spectacled eiders were listed as threatened under the Endangered Species Act in 1993 (Federal Register 1993). Following listing, a recovery team was established to develop and implement the Spectacled Eider Recovery Plan (U.S. Fish and Wildlife Service 1996). This plan developed criteria for delisting the species that requires reaching at least one of the following benchmarks for each of three subpopulations including the Yukon-Kuskokwim Delta (YKD), North Slope Alaska, and Arctic Russia: 1) significant population growth based on Bayesian methods using data from 10-15 years of annual surveys (Taylor et al. 1996) and a population exceeding 6,000 breeding pairs; <u>or</u> 2) a population exceeding 10,000 breeding pairs over three consecutive annual surveys; <u>or</u> 3) a population exceeding 25,000 breeding pairs in any one survey (U.S. Fish and Wildlife Service 1996). The Spectacled Eider Recovery Team identified annual nest surveys as the primary method to assess status relative to recovery criteria for the Yukon-Kuskokwim Delta subpopulation (U.S. Fish and Wildlife Service 1996). Accordingly, assessment of spectacled eider status has been an important objective for annual waterfowl nest surveys conducted since 1985.

METHODS

We used a ground-based sampling procedure to monitor waterbird nest populations and potential production on the YKD coastal zone from 1985 to 2012. Boundaries of the survey area include lands on the Yukon Delta National Wildlife Refuge (YDNWR) surrounding Hazen Bay (Fig. 1). Prior to 1994 and in 1998-99, randomly located plots were selected from various regions on the Yukon-Kuskokwim coastal zone as we accumulated information on the distribution of waterfowl and other birds. Since 2000, plots have been selected within a consistent area of 716 km^2 that was comprised of medium (>1 observed spectacled eiders/km^2) and high (>2 observed spectacled eiders/km^2) density eider nesting habitat as determined by

aerial observations on systematic transects in 1988-1994 (USFWS unpubl. data). Aerial survey crews observe the majority of all spectacled eider pairs in this area, hereafter referred to as the "core nesting area"; yet it represents just 5.6% of the total coastal zone area of 12,832 km^2. The core nesting area specifically excludes several patches of privately owned eider nesting habitat because annual access could not be assured. In this report our estimates of nest population size and egg production for 1985-2012 are based on data collected only from plots within the core nesting area and expanded to the entire coastal zone of the YKD using aerial survey data (see below).

We used GIS and custom-written True BASIC computer programs to randomly select 85 plots within the core nesting area (Fig. 1). Selection of plot locations was restricted by excluding points that resulted in overlap with any other plot within the current year or five years prior. Plot size was 402 m by 805 m (0.32 km^2) in 1988-1994 and 1997-2012. Plot sizes were variable in 1985-1987 (0.16-1.66 km^2), and were 0.45 km^2 in 1995, and 0.36 km^2 in 1996. We drew plot boundaries on aerial photographs (1985-2007) and IKONOS satellite imagery (2008-2011) at a 1:13,000 scale for use as field maps (Fig. 2).

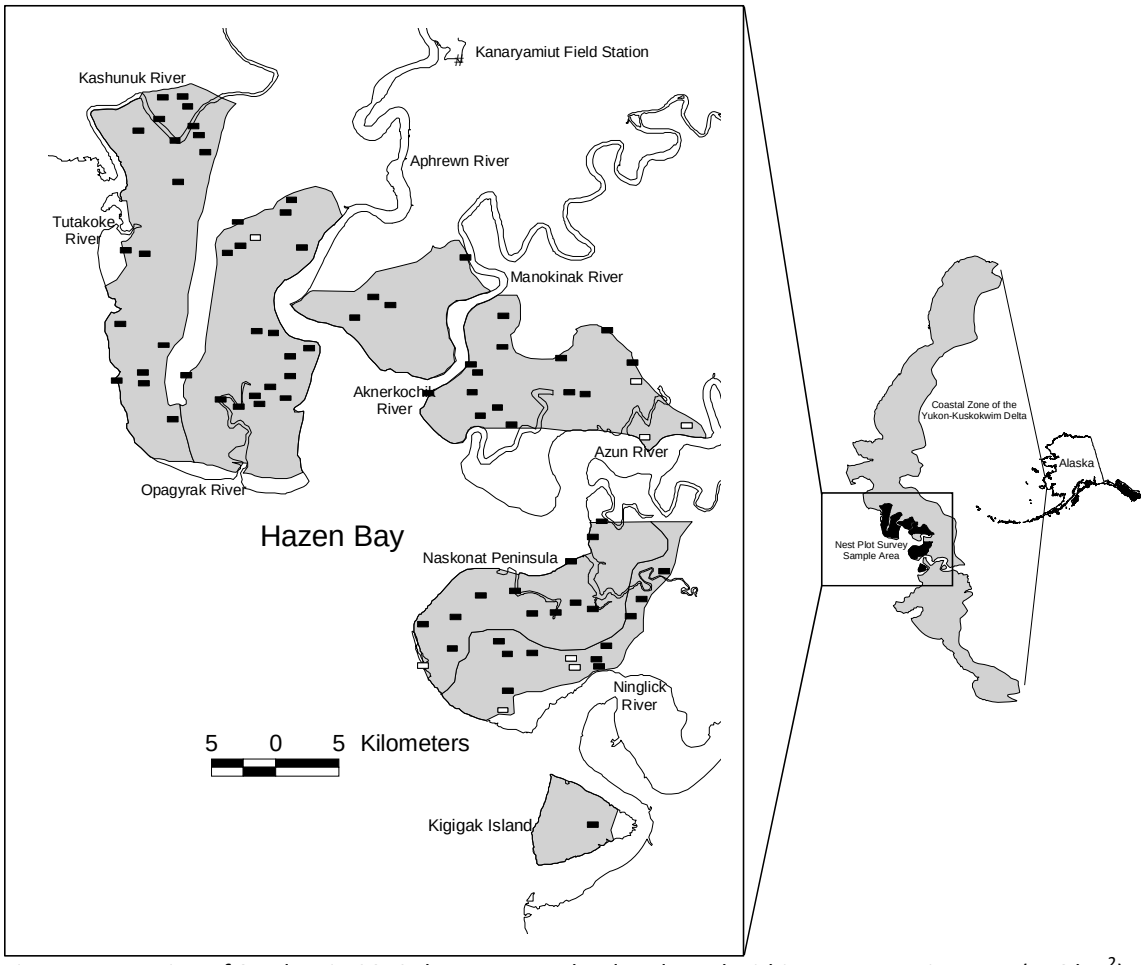


Figure 1. Location of 85 plots in 2012 that were randomly selected within a core nesting area (716 km^2) located within the Yukon-Kuskokwim Delta coastal zone (12,832 km^2), Alaska. Sampled plots are represented by 77 solid rectangles. Eight additional plots were selected but not sampled, shown as open rectangles.

Two to four biologists searched each plot for up to 8 hours depending on crew size, available habitat, nest density, and crew experience. Prior to 2012, crews were transported to plots with a combination of float-equipped aircraft and boat. Starting in 2012, all plots were accessed via boat. Two crews, each equipped with an inflatable skiff, were transported to the Naskonat Peninsula via a Bethel-based float plane. Three crews used 16'-18' aluminum skiffs to access plots near the Aphrewn, Opagyarak, and Kashunuk rivers. Two additional crews were transported to spike camps on the Kashunuk and Aphrewn rivers via a Yukon Delta National Wildlife Refuge (YDNWR) skiff based in the village of Chevak. Data were collected at eight plots by collaborating biologists in adjoining scientific camps including Kigigak Island (YDNWR), Manokinak River (US Geological Survey [USGS]), and Tutakoke River (University of Nevada, Reno [UNR]).

All nesting habitat within a plot was examined for active and destroyed waterfowl, crane, loon, and gull nests. Nesting records of other species were recorded as encountered but most shorebird and passerine nests were likely missed. At each nest we recorded species, nest status (active, destroyed, abandoned), nest site habitat (shoreline, island, peninsula, slough bank, grass meadow, palsa, upland, displaced island), stage of incubation, clutch size, and geographic coordinates. Species identification was determined by visual confirmation of an adult at the nest or by comparing down and contour feathers in the nest bowl with a photographic field guide (Bowman 2008).

We estimated stage of incubation from three eggs per nest by using float angles (Westerskov 1950). We used a 1-9 ordinal scale based on float angles (from sinking to very buoyant with 5 at equilibrium in water) that corresponded to incubation age of **2**, **5**, **8**, **10**, **13**, **15**, **18**, **22**, **24** days, respectively (USFWS unpubl. data on cackling Canada geese). We adjusted the incubation stage for each species based on the average 25 day incubation period of cackling Canada geese adjusted proportionately to average incubation duration for each species (after Afton and Paulus 1992; Table 1). For example, spectacled eider has an incubation period of 24 days; thus, incubation stage 1 indicates 1.9 days old (calculated as **2***[24/25]), where **2** is the estimate in days of a cackling Canada goose egg in incubation stage 1 and 24/25 is the proportional adjustment for spectacled eider incubation duration relative to cackling Canada Geese (see above); incubation stage 2 indicates 4.8 days (calculated as **5***[24/25]), where **5** is the estimate in days of a cackling Canada goose egg in incubation stage 1 (see above); incubation stage 3 indicates 7.7 (**8***24/25); etc. For tundra swan average incubation is 31 days; thus incubation stage 1 indicates 2.5 days (**2***(31/25); incubation stage 2 indicates 6.2 days (**5***31/25); incubation stage 3 indicates 9.9 (**8***31/25); etc.

Figure 2. Example of a field map used by crews to navigate within plot boundaries. Plot size was 402 m x 804 m.

We calculated hatch date as the date of the nest visit plus total average incubation duration (Table 1) minus average days of incubation age based on float angles. We determined nest initiation date (day with first egg laid) as date of nest visitation, minus average age of floated eggs, minus observed clutch size times the laying rate expressed as eggs/day (e.g. 0.75 eggs/day for SPEI, see Table 2-2 in Alisauskas and Ankney 1992), plus 1. For example, the nest initiation date for a spectacled eider nest visited on day 171 (20 June) containing 5 eggs with an average

float angle category of 5 (incubation 12.5 days; Table 1) was calculated as follows: 171-12.5-(5/0.75)+1 = 153, or 2 June. We report hatch date and clutch size estimates in 1982-1984 using data collected by Butler (1983) based on the same techniques described above.

To estimate population sizes of total nests, active nests, and eggs, we first calculated density of nests/km^2 as the total number found divided by the total area searched (number of plots * plot size). For each nest recorded, we also applied a correction factor for imperfect nest detection using a model that includes species, nest status (active, destroyed), observer experience (<150, 150-400, >400 previous nests found), nest site habitat (meadow, slough bank, shoreline, peninsula, island), and down present in nest lining (Bowman and Stehn *manuscript in prep.*). Population size within the core nesting area was then estimated as the detection-corrected density of nests, active nests, and eggs multiplied by total core nesting area of 716 km^2. Next, we calculated estimates for the regions not sampled by ground plots based on aerial survey transect observations collected and reported by Butler et al. (1988), Bollinger (2012), and Platte and Stehn (2013). To do this, we annually calculated the ratio of aerial breeding population indices outside the ground-sampled area ("OUT") to the aerial index within the ground-sampled area ("IN") for each species. We used "OUT:IN" ratios as expansion factors to determine the number of nests and eggs outside of the core nesting area. We then summed the estimates of nests and eggs outside and inside the core nesting area to determine the total estimated populations for the coastal zone of the YKD. For most species (geese, ducks, cranes), the aerial index was based on twice the number of singles plus the number of birds in pairs observed, because observed single geese, cranes and ducks are assumed to be the mates of unobserved females on nests (U.S. Fish and Wildlife Service 1987). Flocks were not included in aerial indices for geese, ducks, swans, or cranes but were included for brant, loons, and gulls. For swans, gulls, and loons, the number of observed single birds was not doubled because unlike ducks, both individuals in a pair are highly visible to aerial observers.

Departing from the method used in previous reports, we did not average or pool OUT:IN ratios across years. This change will result in slight differences in historical annual estimates reported in prior year reports (eg. Fischer et al. 2011). Because aerial survey data were not collected for eiders, other ducks, and loons in 1985-87, and not for gulls and terns until 1992, we substituted the OUT:IN ratios from the nearest year, 1988 or 1992, for missing years. Missing observations in 2011 were replaced by the average of 2010 and 2012 data to calculate the OUT:IN ratio for 2011. Standard errors of the ratios were based on the variance of the quotient of the OUT and IN aerial indices, each considered independent variables with separate variances. The aerial indices were stratified estimates of average observation density as determined by standard index ratio procedures (Cochran 1963, p. 158 eq. 6.4). Variance of the nest population in the OUT region included both the variance of nests and variance of the OUT:IN ratio.

Loon data were treated differently from other species because nest identification of red-throated (*Gavia stellata*) and Pacific loons (*Gavia pacifica*) is difficult. Loons rarely remain near their nest sites when ground crews are present and their nests and eggs are essentially indistinguishable (Bowman 2008). Thus, to determine the relative numbers of Pacific loon nests we calculated the proportion of Pacific loons to total loons based on aerial observations from transects within the core nesting area (Platte and Stehn 2013). We then multiplied this ratio by the total number of loon nests to derive an estimate for Pacific loon nests. We used the same approach to estimate the number of red-throated loon nests.

The estimated total number of nests measures the minimum number of breeding pairs in the population. Some potential breeders may not establish a nest in a given year, and some nests are destroyed or abandoned at an early stage before they can be detected by ground

crews. Nest success (nests with at least one egg hatched/total nests) is not directly measured, but certainly many eggs and hatchlings do not survive the breeding season. Therefore the estimated total number of eggs reported is an index that represents the maximum potential young that could augment the fall population if they survived through the remainder of incubation, brood rearing, and the post-fledging periods. Similarly, the proportion of nests that are active when the plots are searched (active nests/total nests) is an index rather than a true measure of nest success. Definitions of these terms are summarized in the caption of Figure 3.

We describe 2012 estimates compared to the long-term means (1985-2012) with qualitative descriptors that correspond to quartiles (4th quartile = high, 3rd quartile = moderate, 2nd quartile = low, 1st quartile = very low). We report annual estimates of a nest success index and clutch sizes in 1985-2012, and describe the 2012 estimates relative to long-term means with qualitative descriptors that correspond to quartiles (4th quartile = excellent, 3rd quartile = good, 2nd quartile = fair, 1st quartile = poor).

Species nomenclature follows the List of Migratory Birds in Title 50 of the Code of Federal Regulations, Section 10.13, revised 1 March 2010 (79 FR 9282).

RESULTS

We searched 77 plots from 9-21 June, 2012 (Fig. 1) comprising 3.4% of the core nesting area (77 plots x 0.32 km^2/716 km^2). We did not visit eight of the 85 randomly selected plots due to difficult access or weather delays that prevented completion of field work prior to onset of hatch. Together, crews located 3,816 nests within plot boundaries including 1,804 cackling Canada goose, 328 emperor goose, 732 greater white-fronted goose, 188 black brant, 145 spectacled eider, 29 common eider, and 590 nests of other species. Calculations of clutch size and hatch date also included an additional 33 nests located outside of plot boundaries.

We present nest population, egg production, and nest success estimates in figures with accompanying tabulated data for each species (Fig. 4). Estimated initiation and hatch dates for all species are presented in Table 4.

Environmental Conditions 2012

Cold spring temperatures and extensive sea ice in the Bering Sea delayed arrival of summer on the Yukon-Kuskokwim Delta in 2012. Ice extent in the Bering Sea for most the 2011-2012 winter was 20 to 30 percent above the 1979 to 2000 average, influenced largely by persistent northerly winds (NASA National Snow and Ice Data Center 2012). Mean May temperature in Bethel, located approximately 100 miles east of Hazen Bay, was 39.4 F (Weather Underground 2012) and average ice thickness of the Kuskokwim River remained 120% of normal (NOAA 2012). At Bethel, river breakup occurred on 15 May, just three days later than the 41-year average (NOAA 2012), but most freshwater in the core nesting area surrounding Hazen Bay remained frozen throughout the month of May when mean temperature was just 30.5 F (Weather Underground 2012).

Most nesting sites were unavailable until 9 June due to extensive ice and snow cover (Gabrielson 2012). An aerial reconnaissance flight along the coast of Hazen Bay on 3 June, 2012 revealed widespread river and lake ice and some areas with significant snow cover (Brian McCaffery, YDNWR pers. comm., Fig. 3). Breakup of the Ninglick River, south of Kigigak Island, occurred on 8 June but widespread ice continued to flow up and downriver with each tide. Float plane access to coastal sloughs of the Naskonat Peninsula was first possible on 9 June allowing initiation of data collection; however, boat operations were restricted to periods of slack tide due to movement of broken ice in the sloughs. Persistent moving ice on the Kashunuk, Aphrewn, and Opagyarak rivers restricted operation of motorboats there until 12 June (Fig. 3).

Ice continued to flush out of rivers and sloughs along the coast through 15 June. Aside from the delayed thaw of snow and ice, no significant weather events occurred during the primary nesting period in late June.

Figure 3. Images of breakup on the Yukon-Kuskokwim Delta coastal zone, 2012. Left: Widespread ice-covered lakes and ponds on the Opagyarak Peninsula, 3 June, Photo by B. McCaffery; Right: Broken ice on Kashunuk River, 11 June, Photo by J. Fischer.

Cackling Canada Geese (*Branta canadensis minima* [Species nomenclature follows the List of Migratory Birds in Title 50 of the Code of Federal Regulations, Section 10.13, revised 1 March 2010 (79 FR 9282)]).

Numbers of cackling Canada goose nests and eggs were high in 2012 with estimates 67% and 73% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Rates of growth in nests and eggs are significantly positive in the short-term (2003-2012) and long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was excellent; however, clutch size (active eggs/active nest) was very low relative to long-term means (1985-2012; Fig. 4). Average hatch date for cacklers in 2012 was seven days later than the long-term mean (1982-2012; Table 4).

Emperor Geese (*Chen canagica*)

Numbers of emperor goose nests and eggs were moderate in 2012 with estimates 13% and 12% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Nest population growth rate is significantly positive in the short-term (2003-2012) and long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was excellent; however, clutch size (active eggs/active nest) was very low relative to long-term means (1985-2012; Fig. 4). Average hatch date for emperor geese in 2012 was nine days later than the long-term mean (1982-2012; Table 4).

Greater White-fronted Geese (*Anser albifrons frontalis*)

Numbers of greater-white fronted goose nests and eggs in 2012 were moderate and high, respectively. Nest and egg estimates were 84% and 72% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Rates of growth in nests and eggs are significantly positive in the short-term (2003-2012) and long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was good; however, clutch size (active eggs/active nest) was very low relative to long-term means (1985-2012; Fig. 4). Average hatch date for greater white-fronted geese in 2012 was seven days later than the long-term mean (1982-2012; Table 4).

Black Brant (*Branta bernicla nigricans*)

Numbers of black brant nests and eggs in 2012 were low with estimates 44% and 32% below the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Growth rates of nests in the short-term (2003-2012) and long-term (1985-2012) show a stable population. Number of eggs indicate positive growth rate in the short-term, and no change in the long-term (Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was good, and clutch size (active eggs/active nest) was moderate relative to long-term (1985-2012) means (Fig. 4). Average hatch date for black brant in 2012 was eight days later than the long-term mean (1982-2012; Table 4).

Tundra Swans (*Cygnus columbianus*)

Numbers of tundra swan nests were high in 2012 with an estimate 29% above the long-term mean (1985-2012; Fig. 4, Tables 2-3). Numbers of eggs, however, were 17% below the long-term average. Growth rate of nests in the short-term (2003-2012) show a stable population, however number of nests have increased significantly over the long-term (1985-2012; Fig. 4, Tables 2-3). Growth rate of the number of eggs is negative in the short-term, and positive in the long-term (Tables 2-3). Nest success (active nests/total nests) in 2012 was poor and clutch size (active eggs/active nest) was very low relative to long-term (1985-2012) means (Fig. 4). Average hatch date for tundra swans in 2012 was ten days later than the long-term mean (1982-2012; Table 4).

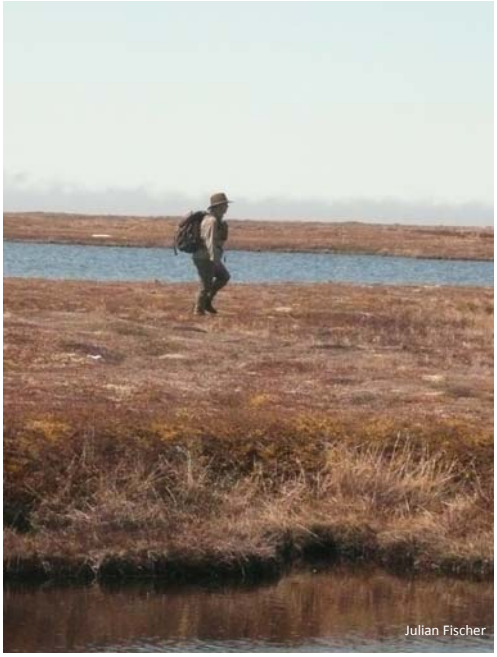
Sandhill Cranes (*Grus canadensis*)

Numbers of sandhill crane nests and eggs in 2012 were low with estimates 4% and 9% below the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Growth rates of nests and eggs are stable in the short-term (2003-2012) and significantly positive in the long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was poor and clutch size (active eggs/active nest) was moderate relative to long-term (1985-2012) means (Fig. 4). Average hatch date for sandhill cranes in 2012 was seven days later than the long-term mean (1982-2012; Table 4).

Spectacled Eiders (*Somateria fischeri*)

Numbers of spectacled eider nests and eggs were high in 2012 with estimates 64% and 78% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Numbers of nests and eggs in 2012 were the highest since 1987. Rates of growth in nests and eggs are significantly positive in the short-term (2003-2012) and stable in the long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was good and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch

date for spectacled eiders in 2012 was six days later than the long-term mean (1982-2012; Table 4).



Common Eiders (*Somateria mollissima*)

Numbers of common eider nests and eggs were moderate in 2012 with estimates 14% and 18% below the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Growth rates of nests and eggs are stable in the short-term (2003-2012) and significantly positive in the long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was fair, and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch date for common eiders in 2012 was six days later than the long-term mean (1982-2012; Table 4).

Gulls and Terns

Colonial nesting seabirds including glaucous gulls (*Larus hyperboreus*), Sabine's gulls (*Xema sabini*), mew gulls (*Larus canus*), and Arctic terns (*Sterna paradisaea*) are not monitored with precision by the nest plot survey. Nonetheless, the survey does provide a measure of potential production for these species.

Estimated numbers of glaucous gull nests and eggs in 2012 were very low relative to long-term means (1985-2012; Fig. 4) with estimates 64% and 61% below the long-term means (1985-2012), respectively and the lowest in the history of the survey. Despite the low annual estimate in 2012, growth rate of nests and eggs both indicate stable populations in the short-term (2003-2012) and long-term periods (1985-2012; Tables 2-3). Nest success (active nests/total nests) in 2012 was fair and clutch size (active eggs/active nest) was low relative to long-term means (1985-2012; Fig. 4). Average hatch date for glaucous gulls in 2012 was eight days later than the long-term mean (1982-2012; Table 4).

Estimated numbers of mew gull nests and eggs in 2012 were moderate relative to long-term means (1985-2012; Fig. 4) with estimates 6% and 15% above the long-term means (1985-2012), respectively. Growth rate of nests and eggs both indicate stable populations in the short-term (2003-2012) and long-term periods (1985-2012; Tables 2-3). Nest success (active nests/total nests) in 2012 was fair and clutch size (active eggs/active nest) was low relative to long-term means (1985-2012; Fig. 4). Average hatch date for mew gulls in 2012 was six days later than the long-term mean (1982-2012; Table 4).

Unlike the larger bodied gulls, numbers of Sabine's gull nests and eggs were high in 2012 with estimates 26% and 36% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Rates of growth in nests and eggs are significantly positive in both the short-term (2003-2012) and long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was excellent and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch date for Sabine's gulls in 2012 was seven days later than the long-term mean (1982-2012; Table 4).

Similar to Sabine's gulls, numbers of Arctic tern nests and eggs were high in 2012 with estimates 96% and 109% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-

3). Rates of growth in nests and eggs are stable in the short-term (2003-2012) and significantly positive in the long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was excellent and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch date for Arctic terns in 2012 was six days later than the long-term mean (1982-2012; Table 4).

Loons

Numbers of red-throated loon nests and eggs in 2012 were very low with estimates 47% and 46% below the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Despite these low estimates, growth rate of nests and eggs both indicate stable populations in the short-term (2003-2012) and long-term periods (1985-2012; Tables 2-3). Nest success (active nests/total nests) in 2012 was fair and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch date for red-throated loons in 2012 was five days later than the long-term mean (1982-2012; Table 4).

Unlike red-throated loons, numbers of Pacific loon nests and eggs were high in 2012 with estimates 31% and 35% above the long-term means (1985-2012), respectively (Fig. 4, Tables 2-3). Rates of growth in nests and eggs are significantly positive in the short-term (2003-2012) and stable in the long-term (1985-2012; Fig. 4, Tables 2-3). Nest success (active nests/total nests) in 2012 was fair and clutch size (active eggs/active nest) was moderate relative to long-term means (1985-2012; Fig. 4). Average hatch date for Pacific loons in 2012 was five days later than the long-term mean (1982-2012; Table 4).

DISCUSSION

Short-term and Long-term Trends

The nest plot survey was specifically designed to provide annual estimates of nest and egg population size and trend, and to measure nest success and hatching dates for five focal species: cackling Canada geese, emperor geese, greater white-fronted geese, spectacled eiders, and common eiders. Data on black brant, tundra swans, sandhill cranes, loons, gulls, and terns were also collected and reported.

In 2012, production of nests and eggs, rates of nest success, and estimates of clutch size varied widely among focal species. The three focal goose species (cackling Canada, emperor, and white-fronted) all exhibited moderate or high production of nests and eggs, and good to excellent nest success. In all three species, however, clutch size was very low relative to long-term means. Similar to the geese, spectacled and common eiders had comparable moderate to high production of nests and eggs, and fair to good nest success. Unlike the geese, however, clutch size for the eiders was moderate. One potential contributing factor to low clutch size may have been the late timing of breakup and snow melt that may have precluded production of larger clutches.

Numbers of nests of four of the five focal species have increased significantly over the 28-year time span of this survey (1985-2012); the one exception being spectacled eiders.

Positive growth in numbers of spectacled eider nests in the short-term is encouraging. Given the relatively high numbers of spectacled eider nests estimated through the late 1980s followed by 11 years of relatively few nests, positive growth will be required in the years ahead before a long-term positive trend will be significant. The 2012 estimate for spectacled eider nests was the highest since 1987. The estimated nest population of spectacled eiders in the single year 1987 is high with a very high sampling error. It is possible the estimate from 1987 is an outlier caused by some undetermined problem with sampling or species identification. However, even excluding the point estimate from 1987 the long-term trend in spectacled eider nests has not increased significantly. Regardless, the high estimate in 2012 reinforces positive signs of continued recent growth in population size.

Status of Spectacled Eiders

Using criteria defined in the Spectacled Eider Recovery Plan, the Yukon-Kuskokwim Delta spectacled eider population is approaching the benchmark for consideration of delisting from Threatened status. For delisting to occur, however, each of three spectacled eider populations (Yukon-Kuskokwim Delta, North Slope Alaska, and Arctic Russia) must show significant population growth using data from 10-15 years of annual surveys or have a population that exceeds 6,000 breeding pairs as measured by the lower 95% confidence interval bound (Taylor et al. 1996; U.S. Fish and Wildlife Service 1996). On the Yukon-Kuskokwim Delta, the growth rate of numbers of nests (a direct surrogate to numbers of breeding pairs) using data from the most recent 15 years is 1.041 with a 95% confidence interval of 1.007 – 1.075. In the single year of 2012, the estimate of nests was 8,062 with a SE of 1,110. Thus, the lower 95% confidence interval bound is 5,886 nests (8,062 – [1.96*1,110]). The 5-year average 2008-2012 was 6211 nests (4580 – 7841, 95% confidence interval.). Taken together, these results indicate that the Yukon-Kuskokwim Delta subpopulation is within around 100-1500 breeding pairs of meeting criteria for delisting.

The Spectacled Eider Recovery Plan specifies alternative criteria for delisting that include a subpopulation exceeding 10,000 breeding pairs over three consecutive annual surveys; or a population exceeding 25,000 breeding pairs in any one survey (Taylor et al. 1996; U.S. Fish

and Wildlife Service 1996). The spectacled eiders subpopulation on the Yukon-Kuskokwim Delta is not close to meeting either of these benchmarks.

Delisting of the spectacled eider from Threatened status requires that all three populations (Yukon-Kuskokwim Delta, North Slope Alaska, and Arctic Russia) meet delisting criteria above outlined above. Breeding and winter population surveys indicate that the Arctic Russia population is well above the 25,000 breeding pair threshold (Hodges and Eldridge 2001, Larned et al. 2012a). In contrast, the North Slope Alaska spectacled eider subpopulation has remained stable since the initiation of breeding pair surveys in 1992 with no indication of significant positive or negative growth (Larned et al. 2012b, Stehn et al. 2013). There, the 2012 indicated total index of spectacled eiders was 4,902 (3,824-5,980, 95% confidence interval; Stehn et al. 2013), well below the 6,000 breeding pair benchmark for delisting. In the most recent 5 years 2008-2012, the average indicated breeding pair index was 6,344 (5201-7487, 95% confidence interval). An aerial detection rate has not been established specifically for spectacled eiders on the North Slope. The average aerial spectacled eider "detection rate" (ratio of breeding birds seen by aerial crews to nests on the ground) on the Yukon-Kuskokwim Delta is 1.133 nests/indicated breeding bird index, based on the 10 years of ratio estimates from 2002-2010 and 2012. If this ratio also applies to the North Slope subpopulation then we would estimate that 5,456 (4,256-6,656, 95% confidence) breeding pairs occurred in that region in 2012 interval [calculated by multiplying the point estimate and the upper and lower confidence estimates by 1.13]. The lower 95% confidence bound (4,256) is 1,744 pairs below the benchmark threshold for delisting. The same technique applied to the ten-year average total breeding birds on the North Slope (6,540, SE=365, 2003-2012) yields an estimate of 7,410 (6,605-8,215, 95% confidence) breeding pairs. In this case, the lower 95% confidence bound (6,605) is 605 pairs above the benchmark threshold for delisting. This highlights the importance of setting consistent and transparent rules regarding how many years of survey data should be used to calculate population indices and estimates of population size for reclassification purposes. Moreover, reclassification criteria should address how to account for incomplete detection in aerial surveys on the Arctic Coastal Plain including how to incorporate variation in detection into confidence bounds of total population size.

Predation

Mammalian and avian and predators are known to destroy nests on the YKD during incubation (Anthony et al. 1991, Bowman and Stehn 2003). In prior studies the proportion of nest loss to foxes in YKD brant colonies was estimated at 0.61 (Raveling 1989). This study does not provide a direct estimate of nest depredation due to Arctic fox (*Alopex lagopus*). However, presence of recent fox activity (indicated by fur, scat, tracks, active dens or direct observations) was noted in 43% of sampled plots in 2012 (Table 5), approximately the same as the long-term mean of 46% (1988-2012). Over the long-term, fox abundance (proportion of plots with recent fox activity) is correlated with nest failure (1-nest success index; $F_{1,23} = 13.86$, $P \leq 0.001$; Figs. 5-6) and fox abundance explained 38% of the variation in nest failure from 1988 to 2012 ($R^2 = 0.38$). In 2012, the average proportion of nest failure among goose and eider nests was 0.10 in plots with fox sign and 0.05 in plots without fox sign. While fox were likely contributors to some egg loss in 2012, they were not solely responsible for depredation. Based on direct observation or peck marks on eggs, observers suspected avian predators were responsible for egg loss at 12% of destroyed nests, although the actual proportion of egg loss to avian predators may have been higher because observers do not always attribute cause of egg loss to a specific predator.

The relationship between voles (*Microtus oeconomus*), foxes and nesting success is unclear. High egg depredation from foxes in 2001 followed a year of unprecedented numbers of

voles (Table 5). One hypothesis for this relationship was that high vole populations in 2000 increased overwinter survival of fox, resulting in above average fox populations in 2001. With a reduced vole population in 2001, foxes turned to bird nests as alternative prey. Given the high frequency of voles in 2009 and 2010, we were concerned that fox populations would increase in 2010 and/or 2011 with negative repercussions for avian nest success if vole populations declined. Vole populations did decline in 2011 and remained below average in 2012 (Table 5), yet there was no evidence suggesting this change resulted in a higher than average nest failure due to fox predation. One interpretation is that vole populations may have declined in fall 2010 or winter 2010/2011 resulting in low fox survival, thereby reducing predation effects on birds in 2011 and 2012. Alternatively, voles may not play any predictable role in population dynamics of foxes.

Phenology

Timing of waterfowl nest initiation is typically correlated with timing of spring breakup (Raveling 1978, Dau and Mickelson 1979). The chronology of spring warming along the coast in 2012 was substantially later than recent decades (see Results, "Environmental Conditions 2012") resulting in the latest nest initiation of cackling Canada geese since 1985. Initiation and hatch dates of waterfowl in 2012 were up to ten days later than long-term means (1982-2012). Despite the late nesting effort in 2012, on average the timing of nesting efforts has advanced seven days since 1982. Since 1982, we estimate that average hatch for cackling geese, for which the most data are available, has occurred 0.223 days earlier each year (Fig. 7). The long-term trend towards earlier nesting is significant over the last 31 years ($F_{1, 29} = 4.864$, $P \leq 0.036$, $R^2 = 0.14$).

Long-term increases in spring temperatures and earlier occurrence of spring events, such as river breakup and nest initiation, are predicted in many climate change models (Root et. al. 2003, IPCC 2007). Potential effects of climate change on YKD nesting habitat are not understood, but may prove to be a significant factor in long-term sustainability of waterfowl populations. Alteration of habitats through sea level rise (erosion, inundation, salinization), melting permafrost, and increased river discharge (accelerated sedimentation rates) could influence current nesting areas. Preliminary analyses indicate that the shoreline boundary of the Yukon Delta National Wildlife Refuge has lost an average of 30 ha/yr to coastal erosion over a recent fifty year period (B. Jones, USGS unpubl. data). Point location data taken at each nest sampled in the ground nesting study (2009-2012) will be incorporated into ongoing cooperative habitat change studies involving USFWS, USGS, and University of Alaska. Standardized pond salinity monitoring (H. Wilson, MBM, unpubl. data) since 2006, and habitat selection and change modeling funded by the Alaska Science Center (C. Ely, USGS, unpubl. data) and the Western Alaska LCC (S. Saalfeld, MBM ongoing) will also provide baseline and trend information needed to assess changes to the waterfowl nesting habitats of the YKD.

Comparison with other Survey Results

The spectacled eider nest success index (number of active nests divided by total nests times 100%, with correction for detection rate) has been variable among years. Plots are visited one time, so our measure of nest success overestimates actual nest success (number of nests that hatch at least one chick/total nests) because some nests undoubtedly fail prior to hatch. In addition, nests destroyed during egg laying (before down is added to the nest bowl) are underestimated because they are seldom detected. Nonetheless, nest success index estimates are measured consistently each year and thus provide a valid index and generally match apparent nest success estimates from Kigigak Island (successful hatched nests/total nests)

where nests are visited every seven days until hatch (Gabrielson et al. 2012; Fig. 8). The largest difference between estimates from these surveys was noted in 2001 and 2003, years of very poor production, where many nest failures may have occurred late in nesting. Alternatively, a localized factor, such as high predator populations, caused low success on Kigigak Island in 2001 and 2003. Sampling error due to local conditions is reduced when sampling occurs over a large portion of the nesting range as in the nest plot survey described here. Like nest success, estimates of clutch size measured on the nest plot survey closely parallel those reported from Kigigak Island (Gabrielson et al. 2012; Fig. 9).

In general, nest population trends from this study parallels trends derived from aerial breeding pair surveys (Bollinger 2012, Platte and Stehn 2013). For example, estimates of cackling goose and greater white-fronted goose nests were at record lows in the mid-1980s prior to adoption of the Yukon-Kuskokwim Delta Goose Management Plan that provided protection for nesting and wintering populations of geese (Pamplin 1986). Data from the ground-based plot survey and from aerial breeding pair surveys (Bollinger 2012) show that by the late-1980s, the cackling Canada goose population of nests and pairs increased rapidly, and peaked in the late-1990s. Since 1999, the trend for cackling Canada geese has been generally stable, though estimates from both surveys showed a temporary drop during the mid 2000s (this study, Bollinger 2012). The dramatic increase in population of greater white-fronted geese from the mid-1980s to present is documented by both aerial (growth rate 1.096; Bollinger 2012) and ground surveys (growth rate 1.092 this study). Unlike populations of the other goose species, emperor geese and black brant did not increase markedly after adoption of the Yukon Delta Goose Management Plan. While long-term trends indicates a slow annual increase for emperor geese in both the ground (growth rate 1.011; this study) and air surveys (growth rate 1.015; Bollinger 2012), black brant growth rates show no significant growth or decline in ground or aerial surveys (growth rates 0.994 and 1.008, respectively).

Photographic methods were initiated in the 1990s to monitor nest populations in the five major brant colonies with greater precision than ground surveys or standard aerial waterfowl surveys (Anthony et al. 1995, Wilson 2013). These surveys indicate a decline in brant nest populations since 1992 (Wilson 2013), whereas nest numbers in the ground sampled area (this study) and the fall and winter counts of the entire Pacific population indicate relative stability (Stehn et al. 2010). There are three hypotheses that may contribute to this dichotomy. Stehn et al. (2011) explored the hypothesis that brant are nesting in increasing proportions in small dispersed colonies or satellite colonies outside primary colonies on the YKD. They found that growth rates outside of the primary colonies are positive in some locations but are not sufficient to offset region-wide declines (Stehn et al. 2011). A second hypothesis is that brant populations are increasing on the Arctic Coastal Plain of Alaska, to some degree offsetting loss of YKD colony brant in the overall Pacific population. There is some support for this explanation in aerial surveys of Alaskan Arctic that show brant have increased significantly since 1986 (Larned et al. 2012b, Stehn et al. 2013). A third hypothesis is that there is bias inherent in the fall and midwinter surveys that mask an actual decline in the Pacific black brant population.

Range of Inference

The population size of nests should not be interpreted as direct estimates of population size. For example, a year with poor nesting conditions may result in fewer nesting attempts (and thus nests), but does not represent a loss of adults from the population. This was particularly apparent in 2001 and 2003 when nesting failures resulted in relatively low estimates of spectacled eider nests and eggs, whereas aerial surveys documented numbers of pairs close to long-term means (Platte and Stehn 2013). Similarly, relatively few spectacled eider nests

were constructed in 2011, but pairs were seen by ground crews on 81% of plots sampled, a rate similar to 2008-2010 when spectacled eider population indices were the highest on record (Platte and Stehn 2013). In 2012, the number of spectacled eider nests rebounded to the highest estimate since 1987; thus, we believe the relatively low estimate in 2011 was due to a temporary reduced breeding effort in 2011 or a substantial nesting failure during early incubation prior to the initiation of field work.

Inter-annual variation in nest population size, as described above, highlights the importance of long-term data collection. Annual changes in nest population size are less informative than long-term trends because of sampling error, changes in observers, distribution of plots, and small sample size for less common species. Only several years of consistent declines or increases will indicate a true change in the number of nests and eggs produced on the Yukon-Kuskokwim coastal zone. We believe that a graphical presentation (Fig. 4) enables better interpretation of data than analysis of year-to-year changes in population size. A primary advantage of the random nest plot sampling procedure over intensive local studies is that it assures applicability of estimates for the entire core nesting areas, not just the immediate areas around biological study camps. Moreover, the single brief visit to scattered plots ensures that the monitoring of populations occurs with minimum disturbance.

Summary

In 2012, the number of spectacled eider nests was the highest estimate since 1987. Nest success was good and clutch size was moderate relative to long-term means. Geese (cackling Canada, emperor, and white-fronted) exhibited moderate or high production of nests and eggs, and good to excellent nest success; yet clutch size was very low relative to long-term means. Data from the focal species sampled in this ground-based survey suggest that numbers of nests on the Yukon-Kuskokwim Delta are stable or increasing in the short-term (2003-2012), long-term (1985-2012), or both. No declines in population size are apparent. It appears that waterfowl are responding adequately to variability in onset of spring as witnessed in a significant advance in nesting activity since 1982 and stable or increasing population sizes.

The Yukon-Kuskokwim Delta and Arctic Russia spectacled eider subpopulations are very close to, or above benchmark criteria for consideration of delisting from the Threatened status, but based on the Spectacled Eider Recovery Plan, no subpopulations can be considered for delisting until all three subpopulations meet minimum thresholds. Currently the Alaska North Slope subpopulation does not meet delisting criteria due to absence of significant positive growth and an estimate of fewer than 6,000 breeding pairs based on the 2012 survey. We recommend the Spectacled Eider Recovery Team initiate a review of the 1996 reclassification criteria to determine if analytical techniques should be updated with contemporary methods.

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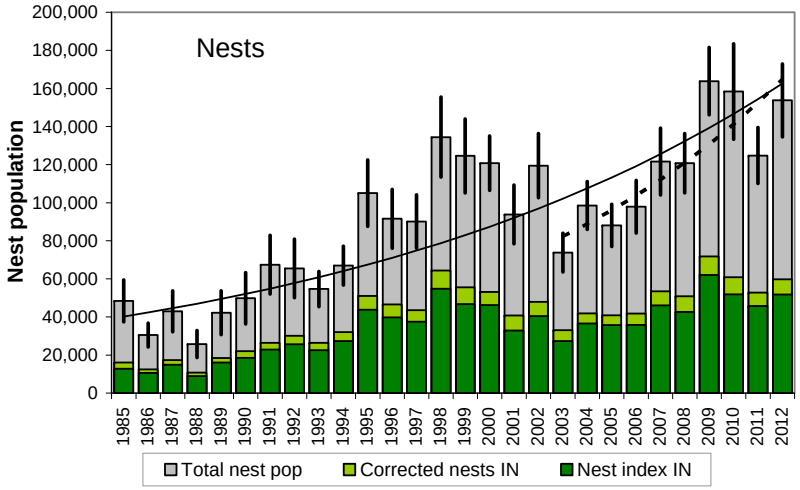
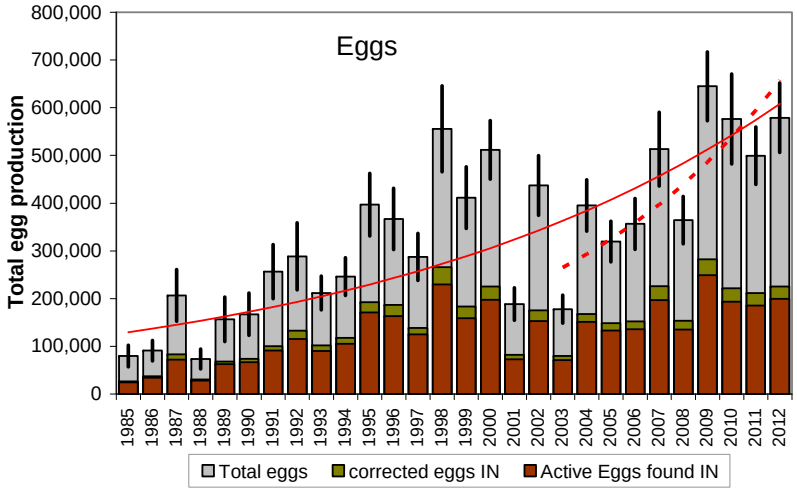
Figure 4 (Subsequent pages). Population size with ± 90% confidence intervals and trends of waterbird nests and egg production on the Yukon-Kuskokwim Delta Alaska, 1985-2012, with accompanying tabulated data. Column heading definitions follow:

Year = survey year;
N plots = number of ground sampled plots used in the analysis;
Sampled km^2 = total area searched (N plots*plot size);
Nest index IN = number of nests within the core 716 km^2 ground sampled area uncorrected for nest detection;
SE nest index IN= standard error for nest index;
Avg nest detection rate = annual proportion of nests detected based on predictive model that includes the covariates of species, nest status, habitat, and observer experience;
Corrected nests IN = Nest index in ground sampled area corrected for nest detection;
Aerial Out:In 7 yr ratio = Average ratio of aerial observations seen out of the ground sampled area vs. in the ground sampled area
Corrected nests OUT = number of nests extrapolated beyond the ground sampled area based on the Aerial Out:In ratio, corrected for nest detection rate;
Total nests In+Out = "Corrected nest IN" + "Corrected nests Out"
SE total nests = standard error for total nest estimate;
Total eggs In+Out = total number of viable eggs at time of plot search in the YKD coastal zone, corrected for detection rate;
SE total eggs = standard error for total egg estimate;
Total eggs/active nests = total viable eggs In+Out divided by the nests with eggs In+Out, corrected for detection rate;
Corrected % nest success index = number of active nests divided by total nests times 100%, corrected for detection rate

CCGO Cackling Goose



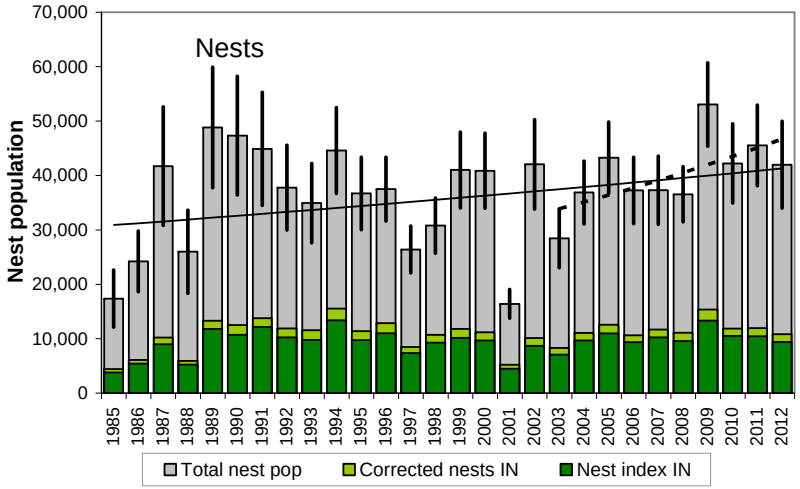
1985-2012 avg annual growth rate= 1.053 (90%c.i.= 1.043-1.064)
2003-2012 avg annual growth rate= 1.080 (90%c.i.= 1.054-1.107)



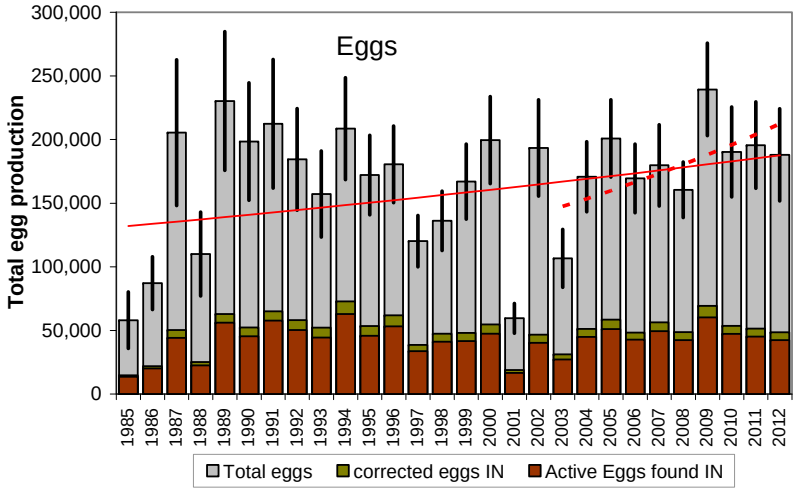
1985-2012 avg annual growth rate= 1.059 (90%c.i.= 1.043-1.075)
2003-2012 avg annual growth rate= 1.106 (90%c.i.= 1.058-1.156)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN	Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	12,788	1,625	79.2%	16,149	1.995	32,216	**48,365**	6,676	**79,771**	13,748	3.91	42%
1986	46	22.16	10,594	1,406	85.0%	12,467	1.444	18,002	**30,469**	3,818	**91,057**	13,116	4.89	61%
1987	37	12.67	14,909	2,693	86.1%	17,319	1.483	25,687	**43,007**	6,544	**206,640**	32,996	5.12	94%
1988	32	10.48	8,947	1,912	83.2%	10,749	1.397	15,021	**25,770**	4,315	**73,386**	12,590	4.52	63%
1989	23	7.45	16,053	3,536	87.3%	18,390	1.294	23,796	**42,185**	6,998	**156,666**	28,379	4.85	77%
1990	33	10.70	18,465	3,890	83.9%	21,997	1.264	27,815	**49,812**	8,200	**167,174**	26,847	4.55	74%
1991	36	11.66	22,840	3,763	86.5%	26,414	1.553	41,028	**67,442**	9,355	**256,599**	34,366	4.64	82%
1992	42	13.39	25,662	4,554	85.3%	30,098	1.173	35,304	**65,402**	9,342	**288,319**	42,749	4.82	91%
1993	47	15.23	22,469	2,877	85.4%	26,323	1.076	28,322	**54,646**	5,626	**211,650**	21,529	4.51	86%
1994	41	13.27	27,391	3,099	85.5%	32,051	1.090	34,928	**66,978**	6,242	**246,251**	24,019	4.58	80%
1995	50	22.56	43,839	5,413	85.9%	51,015	1.058	53,970	**104,985**	10,605	**396,791**	39,987	4.46	85%
1996	54	19.44	39,761	4,827	85.3%	46,617	0.964	44,916	**91,532**	9,373	**366,991**	39,062	4.49	89%
1997	72	23.31	37,516	4,527	86.1%	43,550	1.070	46,617	**90,167**	8,526	**287,214**	29,832	4.03	79%
1998	64	20.71	54,802	6,330	85.1%	64,403	1.088	70,076	**134,479**	12,779	**555,904**	54,837	4.47	92%
1999	53	16.97	46,698	5,561	84.1%	55,508	1.244	69,074	**124,582**	11,784	**411,500**	39,220	3.89	85%
2000	80	25.86	46,279	3,884	87.0%	53,165	1.270	67,541	**120,706**	8,677	**511,906**	37,225	4.50	94%
2001	81	26.23	32,937	3,999	80.7%	40,799	1.299	53,016	**93,815**	9,398	**188,511**	20,630	3.64	55%
2002	84	27.15	40,438	3,989	84.3%	47,948	1.492	71,518	**119,467**	10,248	**437,177**	37,942	4.42	83%
2003	83	26.87	27,323	2,905	82.6%	33,071	1.233	40,788	**73,859**	6,179	**177,886**	17,640	3.96	61%
2004	81	26.22	36,574	3,024	87.5%	41,818	1.356	56,697	**98,515**	7,627	**395,182**	32,856	4.72	85%
2005	83	26.87	35,666	3,192	87.2%	40,898	1.153	47,137	**88,035**	6,772	**319,740**	25,799	4.27	85%
2006	75	24.28	35,842	3,708	85.9%	41,706	1.348	56,209	**97,914**	8,389	**356,660**	32,362	4.43	82%
2007	79	25.58	46,112	4,684	86.2%	53,492	1.273	68,098	**121,590**	10,680	**513,382**	46,953	4.60	92%
2008	82	26.55	42,566	3,963	83.7%	50,846	1.375	69,899	**120,745**	9,473	**364,555**	30,167	4.06	74%
2009	81	26.24	62,090	4,476	86.5%	71,807	1.282	92,054	**163,860**	10,753	**644,838**	43,884	4.34	91%
2010	66	21.37	51,850	5,637	85.2%	60,861	1.602	97,493	**158,354**	15,223	**576,305**	57,226	4.21	86%
2011	82	26.55	45,690	3,602	86.5%	52,806	1.363	71,986	**124,791**	8,938	**499,323**	36,558	4.35	92%
2012	77	24.94	51,765	4,218	86.5%	59,828	1.570	93,924	**153,752**	11,650	**579,085**	44,267	4.08	92%

EMGO Emperor Goose



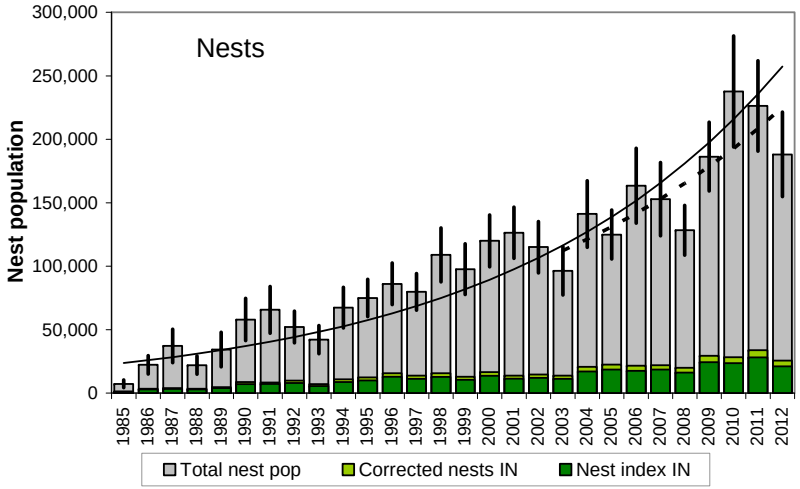
1985-2012 avg annual growth rate= 1.011 (90%c.i.= 1.000-1.022)
2003-2012 avg annual growth rate= 1.036 (90%c.i.= 1.012-1.062)



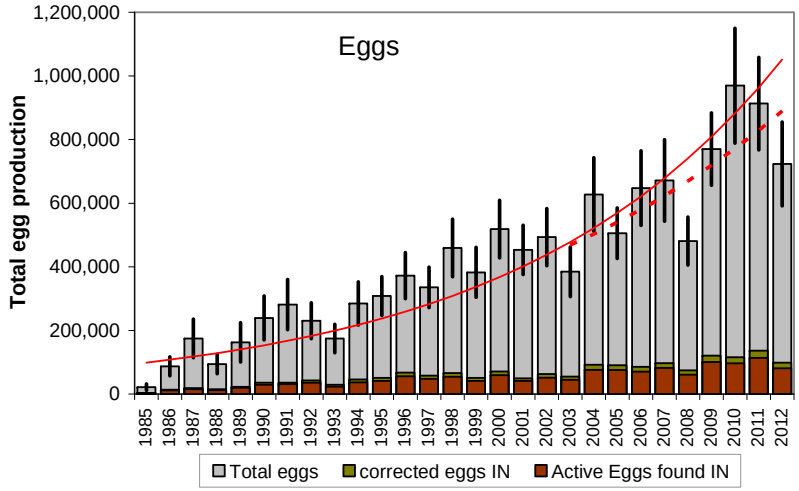
1985-2012 avg annual growth rate= 1.013 (90%c.i.= 0.999-1.027)
2003-2012 avg annual growth rate= 1.041 (90%c.i.= 1.008-1.076)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN	Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	3,816	685	86.5%	4,411	2.936	12,950	**17,361**	3,180	**58,000**	13,450	5.67	59%
1986	46	22.16	5,426	620	89.0%	6,096	2.974	18,129	**24,225**	3,387	**87,140**	12,622	4.93	73%
1987	37	12.67	8,979	1,477	87.9%	10,218	3.084	31,513	**41,731**	6,635	**205,416**	34,793	5.12	96%
1988	32	10.48	5,259	981	88.5%	5,942	3.373	20,045	**25,988**	4,650	**110,072**	20,064	4.70	90%
1989	23	7.45	11,824	1,769	88.9%	13,306	2.670	35,530	**48,836**	6,752	**230,286**	33,092	5.12	92%
1990	33	10.70	10,704	1,299	85.7%	12,490	2.789	34,836	**47,326**	6,618	**198,478**	28,050	4.91	85%
1991	36	11.66	12,157	1,812	88.4%	13,758	2.264	31,142	**44,900**	6,315	**212,362**	30,669	4.89	97%
1992	42	13.39	10,265	1,372	86.2%	11,906	2.173	25,868	**37,774**	4,743	**184,421**	24,253	5.07	96%
1993	47	15.23	9,777	1,116	84.5%	11,571	2.019	23,357	**34,928**	4,436	**157,136**	20,569	4.78	94%
1994	41	13.27	13,372	1,647	85.9%	15,561	1.865	29,020	**44,581**	4,794	**208,610**	24,345	4.99	94%
1995	50	22.56	9,738	1,127	85.5%	11,389	2.223	25,316	**36,706**	4,052	**172,136**	18,985	4.86	96%
1996	54	19.44	11,008	1,105	85.6%	12,866	1.915	24,636	**37,502**	3,571	**180,571**	18,272	5.14	94%
1997	72	23.31	7,368	736	87.1%	8,461	2.119	17,926	**26,387**	2,613	**120,153**	12,271	4.78	95%
1998	64	20.71	9,295	964	86.7%	10,719	1.874	20,086	**30,806**	3,089	**136,130**	14,211	4.64	95%
1999	53	16.97	10,166	875	86.2%	11,794	2.478	29,221	**41,015**	4,243	**166,974**	17,931	4.44	92%
2000	80	25.86	9,715	929	86.9%	11,185	2.653	29,672	**40,856**	4,200	**199,499**	20,830	4.98	98%
2001	81	26.23	4,503	478	86.4%	5,209	2.148	11,188	**16,398**	1,608	**59,479**	7,073	4.81	75%
2002	84	27.15	8,699	942	85.8%	10,142	3.145	31,898	**42,040**	4,994	**193,287**	22,998	4.98	92%
2003	83	26.87	7,057	768	84.9%	8,311	2.424	20,149	**28,461**	3,295	**106,667**	13,876	4.79	78%
2004	81	26.22	9,690	909	87.7%	11,051	2.336	25,813	**36,865**	3,521	**170,706**	16,709	4.88	95%
2005	83	26.87	10,948	812	87.0%	12,588	2.439	30,697	**43,285**	3,994	**200,858**	18,428	4.97	93%
2006	75	24.28	9,373	957	88.0%	10,648	2.500	26,624	**37,272**	3,716	**169,471**	16,445	4.78	95%
2007	79	25.58	10,241	976	87.6%	11,688	2.190	25,601	**37,288**	3,814	**179,736**	19,443	4.98	97%
2008	82	26.55	9,570	782	86.2%	11,103	2.293	25,457	**36,561**	3,092	**160,421**	13,264	4.81	91%
2009	81	26.24	13,340	1,137	86.8%	15,369	2.453	37,704	**53,073**	4,661	**239,437**	22,032	4.71	96%
2010	66	21.37	10,517	1,118	88.6%	11,873	2.555	30,340	**42,213**	4,427	**190,299**	21,493	4.62	98%
2011	82	26.55	10,459	994	87.6%	11,945	2.811	33,576	**45,521**	4,506	**195,615**	20,670	4.41	97%
2012	77	24.94	9,412	831	86.7%	10,851	2.869	31,131	**41,981**	4,859	**187,921**	21,966	4.59	98%

WFGO White-fronted Goose



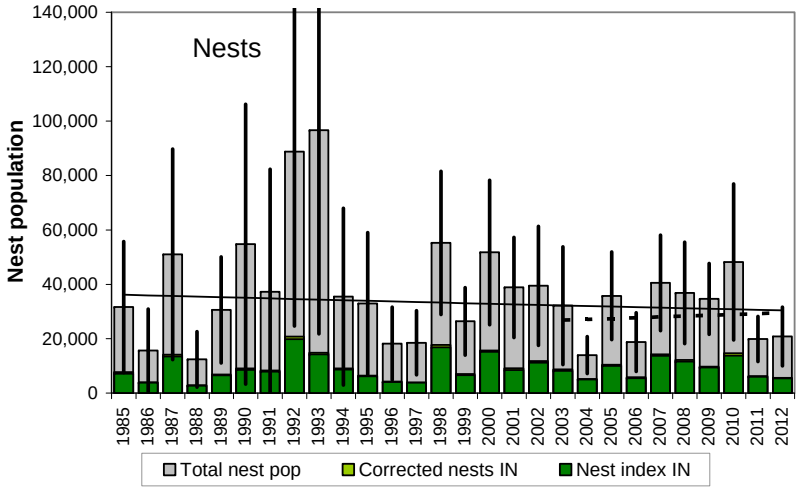
1985-2012 avg annual growth rate= 1.092 (90%c.i.= 1.078-1.106)
2003-2012 avg annual growth rate= 1.080 (90%c.i.= 1.049-1.113)



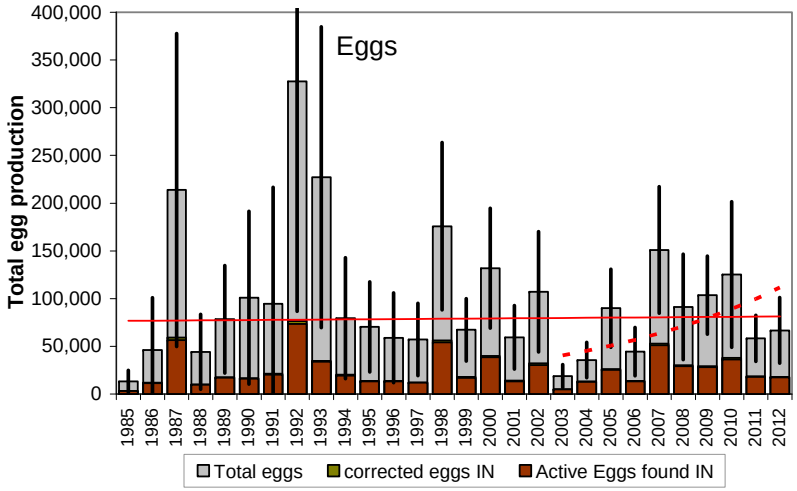
1985-2012 avg annual growth rate= 1.092 (90%c.i.= 1.075-1.109)
2003-2012 avg annual growth rate= 1.074 (90%c.i.= 1.035-1.114)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	1,078	257	81.0%	1,331	4.522	6,019	**7,350**	1,816	**21,715**	6,165	4.20	70%
1986	46	22.16	2,907	463	83.2%	3,493	5.376	18,778	**22,270**	4,424	**86,685**	18,096	4.37	89%
1987	37	12.67	3,275	629	81.4%	4,026	8.226	33,116	**37,141**	7,964	**174,833**	36,910	4.90	96%
1988	32	10.48	2,937	576	83.7%	3,509	5.282	18,533	**22,043**	4,336	**94,499**	18,749	4.40	98%
1989	23	7.45	4,037	1,004	84.9%	4,753	6.208	29,507	**34,260**	8,285	**162,572**	37,428	5.01	95%
1990	33	10.70	7,025	1,108	81.0%	8,674	5.679	49,263	**57,938**	10,084	**239,146**	42,114	4.45	93%
1991	36	11.66	7,184	1,009	86.1%	8,345	6.865	57,291	**65,636**	11,235	**280,870**	47,911	4.53	94%
1992	42	13.39	8,019	1,001	82.6%	9,710	4.362	42,355	**52,065**	7,609	**230,387**	34,443	4.52	98%
1993	47	15.23	5,641	853	80.4%	7,015	4.997	35,050	**42,064**	6,757	**174,546**	27,384	4.27	97%
1994	41	13.27	8,789	1,097	81.3%	10,813	5.228	56,528	**67,341**	9,708	**284,768**	41,410	4.34	97%
1995	50	22.56	9,992	1,093	81.0%	12,340	5.074	62,613	**74,953**	8,961	**308,174**	37,373	4.26	97%
1996	54	19.44	12,849	1,303	82.6%	15,558	4.534	70,547	**86,105**	10,025	**372,290**	43,969	4.49	96%
1997	72	23.31	11,298	1,145	81.7%	13,823	4.772	65,961	**79,783**	8,786	**335,254**	38,736	4.28	98%
1998	64	20.71	12,785	1,320	81.7%	15,657	5.956	93,249	**108,906**	12,884	**459,372**	55,005	4.33	97%
1999	53	16.97	10,588	1,157	82.4%	12,853	6.597	84,788	**97,641**	12,114	**382,657**	47,809	4.17	94%
2000	80	25.86	13,646	1,258	82.9%	16,461	6.285	103,457	**119,918**	12,431	**518,199**	55,012	4.45	97%
2001	81	26.23	11,407	935	82.8%	13,775	8.172	112,578	**126,353**	12,226	**453,365**	47,101	3.86	93%
2002	84	27.15	11,994	1,001	81.6%	14,694	6.825	100,280	**114,974**	12,303	**493,098**	54,715	4.39	98%
2003	83	26.87	11,265	1,151	81.8%	13,773	5.992	82,532	**96,305**	11,588	**384,189**	47,536	4.25	94%
2004	81	26.22	17,059	1,465	82.7%	20,638	5.840	120,536	**141,174**	15,943	**626,956**	70,447	4.59	97%
2005	83	26.87	18,432	1,472	82.2%	22,421	4.571	102,491	**124,912**	11,767	**505,765**	48,443	4.24	96%
2006	75	24.28	17,685	1,571	82.1%	21,537	6.585	141,827	**163,363**	17,922	**647,317**	71,213	4.15	96%
2007	79	25.58	18,579	1,518	84.4%	22,017	5.940	130,768	**152,785**	17,532	**671,280**	77,831	4.47	98%
2008	82	26.55	16,175	1,124	80.8%	20,010	5.415	108,360	**128,370**	11,902	**480,801**	45,934	4.05	92%
2009	81	26.24	24,252	1,481	82.7%	29,327	5.351	156,944	**186,271**	16,514	**770,036**	69,065	4.30	96%
2010	66	21.37	23,614	1,738	83.2%	28,397	7.366	209,164	**237,561**	26,608	**969,369**	109,908	4.19	97%
2011	82	26.55	28,169	1,575	83.5%	33,736	5.707	192,520	**226,256**	21,664	**913,009**	88,336	4.10	98%
2012	77	24.94	21,005	1,794	82.3%	25,518	6.371	162,584	**188,102**	20,284	**723,455**	80,323	3.99	96%

BRAN **Black Brant**



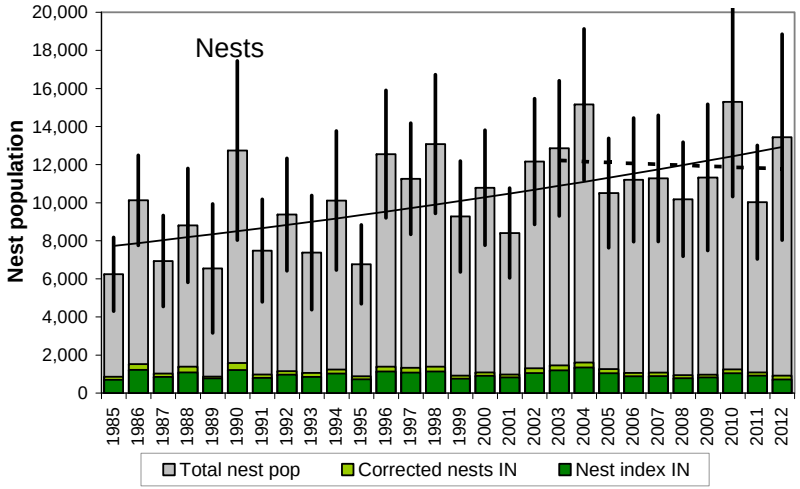
1985-2012 avg annual growth rate= 0.994 (90%c.i.= 0.974-1.014)
2003-2012 avg annual growth rate= 1.011 (90%c.i.= 0.935-1.092)



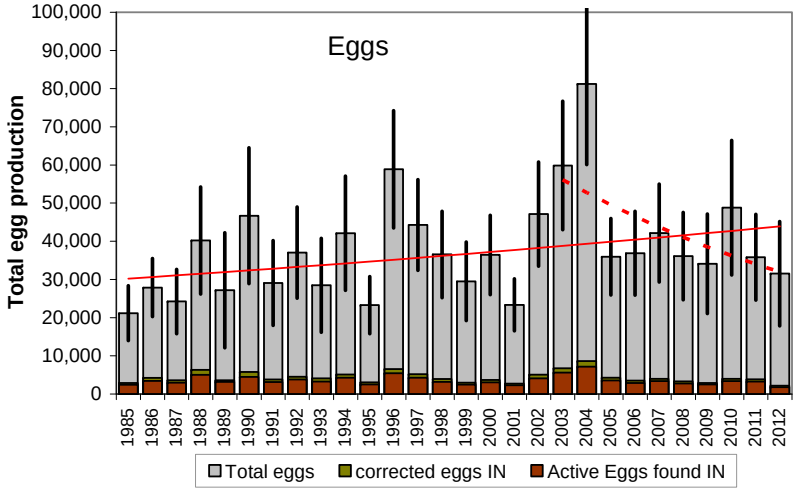
1985-2012 avg annual growth rate= 1.002 (90%c.i.= 0.975-1.030)
2003-2012 avg annual growth rate= 1.119 (90%c.i.= 1.010-1.240)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN	Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	7,107	2,569	92.6%	7,675		3.123	23,969	**31,643**	14,659	**13,223**	7,031	3.09	14%
1986	46	22.16	3,844	2,304	95.7%	4,017		2.900	11,652	**15,669**	9,276	**46,086**	33,315	3.99	74%
1987	37	12.67	13,497	6,158	95.6%	14,117		2.614	36,895	**51,012**	23,528	**213,772**	99,671	4.26	98%
1988	32	10.48	2,732	1,554	95.9%	2,848		3.363	9,577	**12,425**	6,190	**44,237**	23,815	3.98	89%
1989	23	7.45	6,537	2,701	94.8%	6,893		3.436	23,685	**30,578**	11,862	**78,403**	34,288	3.49	73%
1990	33	10.70	8,563	4,710	94.7%	9,047		5.056	45,745	**54,792**	31,279	**100,888**	55,075	3.15	58%
1991	36	11.66	7,859	6,513	94.3%	8,335		3.476	28,972	**37,306**	27,386	**94,736**	73,994	3.66	69%
1992	42	13.39	19,835	9,859	95.6%	20,742		3.278	67,992	**88,734**	38,936	**327,700**	146,550	3.87	95%
1993	47	15.23	14,196	6,832	95.7%	14,838		5.515	81,829	**96,668**	45,531	**227,141**	95,855	3.23	73%
1994	41	13.27	8,681	5,693	96.0%	9,047		2.920	26,414	**35,461**	19,750	**79,508**	38,549	2.42	93%
1995	50	22.56	6,186	3,119	96.5%	6,410		4.139	26,528	**32,937**	15,875	**70,389**	28,704	2.98	72%
1996	54	19.44	4,050	2,022	95.6%	4,235		3.293	13,947	**18,182**	8,144	**58,919**	28,632	3.75	87%
1997	72	23.31	3,807	1,423	96.7%	3,938		3.690	14,532	**18,470**	7,182	**57,157**	23,004	3.32	93%
1998	64	20.71	16,862	5,452	95.3%	17,702		2.120	37,523	**55,226**	16,033	**175,831**	53,390	3.67	87%
1999	53	16.97	6,581	2,064	94.1%	6,991		2.776	19,405	**26,396**	7,560	**67,315**	19,900	3.16	81%
2000	80	25.86	15,140	5,069	96.6%	15,679		2.299	36,044	**51,723**	16,134	**131,782**	38,190	2.87	89%
2001	81	26.23	8,487	2,391	92.7%	9,156		3.241	29,677	**38,833**	11,191	**59,386**	20,271	2.95	52%
2002	84	27.15	11,177	4,344	94.8%	11,792		2.344	27,640	**39,431**	13,296	**107,264**	38,318	3.12	87%
2003	83	26.87	8,229	4,048	94.1%	8,741		2.680	23,422	**32,163**	13,153	**18,787**	7,291	1.25	47%
2004	81	26.22	4,968	1,710	95.7%	5,192		1.695	8,801	**13,993**	4,111	**35,552**	11,191	3.28	77%
2005	83	26.87	10,015	2,732	96.4%	10,385		2.444	25,380	**35,765**	9,795	**89,973**	24,835	3.02	83%
2006	75	24.28	5,541	1,993	95.4%	5,810		2.231	12,963	**18,773**	6,580	**44,475**	15,437	3.44	69%
2007	79	25.58	13,711	4,083	96.5%	14,214		1.853	26,344	**40,557**	10,680	**150,990**	40,220	3.94	95%
2008	82	26.55	11,619	4,337	95.5%	12,169		2.028	24,674	**36,843**	11,336	**91,232**	33,649	3.20	77%
2009	81	26.24	9,384	2,276	96.1%	9,769		2.543	24,843	**34,612**	7,932	**103,587**	24,886	3.56	84%
2010	66	21.37	13,833	5,850	94.6%	14,618		2.299	33,602	**48,219**	17,433	**125,336**	46,374	3.29	79%
2011	82	26.55	6,038	1,550	95.7%	6,307		2.156	13,598	**19,906**	5,022	**58,412**	14,608	3.72	79%
2012	77	24.94	5,395	1,693	96.6%	5,583		2.727	15,223	**20,806**	6,553	**66,704**	20,880	3.66	88%

TUSW Tundra Swan



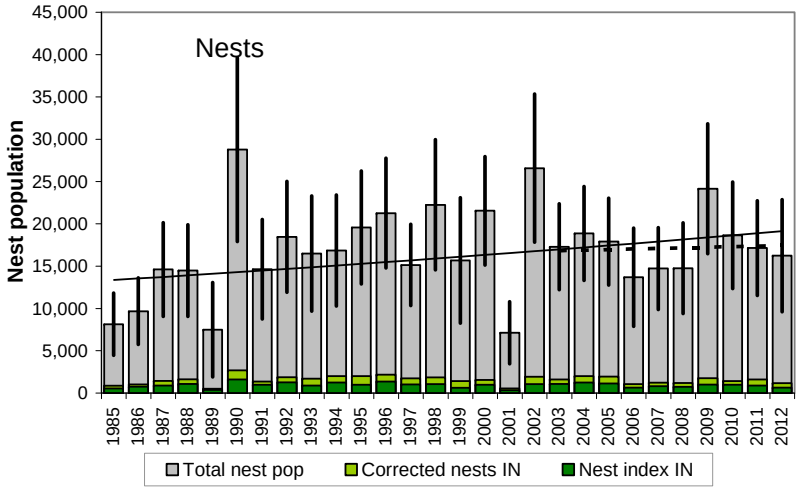
1985-2012 avg annual growth rate= 1.019 (90%c.i.= 1.011-1.027)
2003-2012 avg annual growth rate= 0.996 (90%c.i.= 0.967-1.026)



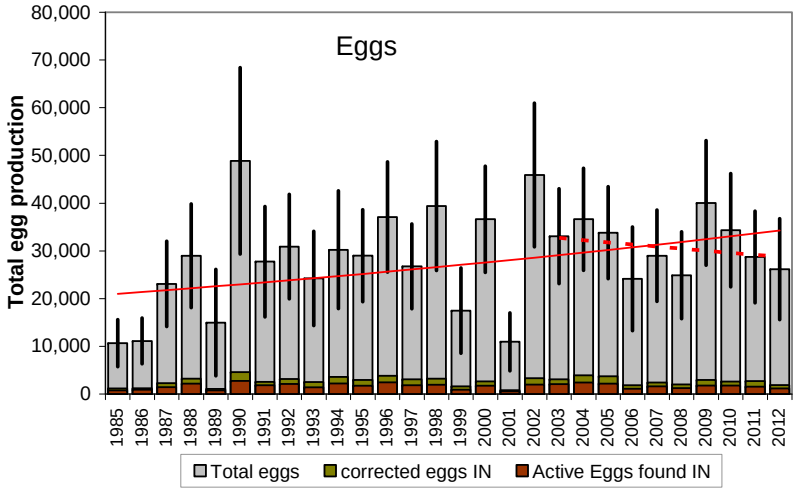
1985-2012 avg annual growth rate= 1.014 (90%c.i.= 1.003-1.026)
2003-2012 avg annual growth rate= 0.939 (90%c.i.= 0.899-0.981)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	699	119	81.0%	863	6.234	5,378	**6,240**	1,176	**21,172**	4,377	3.93	86%
1986	46	22.16	1,227	166	80.4%	1,527	5.632	8,600	**10,126**	1,438	**27,865**	4,616	3.21	86%
1987	37	12.67	847	189	82.5%	1,027	5.753	5,909	**6,936**	1,454	**24,255**	5,115	3.50	100%
1988	32	10.48	1,093	237	78.7%	1,388	5.347	7,419	**8,807**	1,817	**40,224**	8,528	4.57	100%
1989	23	7.45	769	263	88.5%	869	6.533	5,679	**6,549**	2,058	**27,205**	9,158	4.15	100%
1990	33	10.70	1,204	288	76.3%	1,579	7.070	11,165	**12,744**	2,862	**46,708**	10,807	3.92	93%
1991	36	11.66	798	178	81.8%	976	6.664	6,505	**7,482**	1,638	**29,087**	6,766	4.25	92%
1992	42	13.39	962	174	83.5%	1,152	7.137	8,224	**9,376**	1,793	**37,039**	7,262	3.95	100%
1993	47	15.23	846	226	79.6%	1,063	5.947	6,319	**7,381**	1,827	**28,480**	7,483	4.07	95%
1994	41	13.27	1,024	231	82.8%	1,237	7.178	8,878	**10,115**	2,220	**42,121**	9,092	4.16	100%
1995	50	22.56	730	135	82.1%	889	6.609	5,874	**6,763**	1,260	**23,291**	4,539	3.79	91%
1996	54	19.44	1,141	177	82.2%	1,389	8.039	11,162	**12,550**	2,035	**58,878**	9,337	4.89	96%
1997	72	23.31	1,074	155	81.0%	1,326	7.491	9,932	**11,258**	1,774	**44,295**	7,222	4.20	94%
1998	64	20.71	1,140	182	81.7%	1,396	8.371	11,688	**13,084**	2,214	**36,552**	6,880	3.10	90%
1999	53	16.97	759	145	82.2%	924	9.041	8,353	**9,276**	1,769	**29,530**	6,259	3.63	88%
2000	80	25.86	913	153	84.2%	1,085	8.938	9,696	**10,781**	1,835	**36,438**	6,329	3.62	93%
2001	81	26.23	819	134	83.1%	986	7.536	7,427	**8,413**	1,435	**23,360**	4,155	3.38	82%
2002	84	27.15	1,054	166	80.9%	1,303	8.330	10,857	**12,160**	2,009	**47,119**	8,296	4.35	89%
2003	83	26.87	1,198	187	82.7%	1,449	7.876	11,408	**12,857**	2,158	**59,861**	10,226	4.79	97%
2004	81	26.22	1,337	189	83.2%	1,608	8.427	13,549	**15,157**	2,416	**81,222**	12,844	5.48	98%
2005	83	26.87	1,039	150	82.5%	1,259	7.345	9,247	**10,506**	1,745	**35,978**	6,102	3.63	94%
2006	75	24.28	884	143	83.3%	1,062	9.546	10,136	**11,198**	1,973	**36,857**	6,680	3.54	93%
2007	79	25.58	895	154	83.6%	1,071	9.526	10,205	**11,276**	2,017	**42,169**	7,792	3.87	97%
2008	82	26.55	782	127	83.3%	939	9.844	9,242	**10,180**	1,818	**36,128**	6,962	3.85	92%
2009	81	26.24	818	155	84.3%	971	10.668	10,360	**11,331**	2,338	**34,102**	7,910	3.40	88%
2010	66	21.37	1,038	201	83.5%	1,244	11.293	14,046	**15,290**	3,021	**48,800**	10,717	3.87	83%
2011	82	26.55	917	159	84.4%	1,086	8.231	8,939	**10,026**	1,816	**35,867**	6,822	3.81	94%
2012	77	24.94	717	158	77.6%	924	13.553	12,522	**13,446**	3,288	**31,543**	8,302	3.05	77%

SACR Sandhill Crane



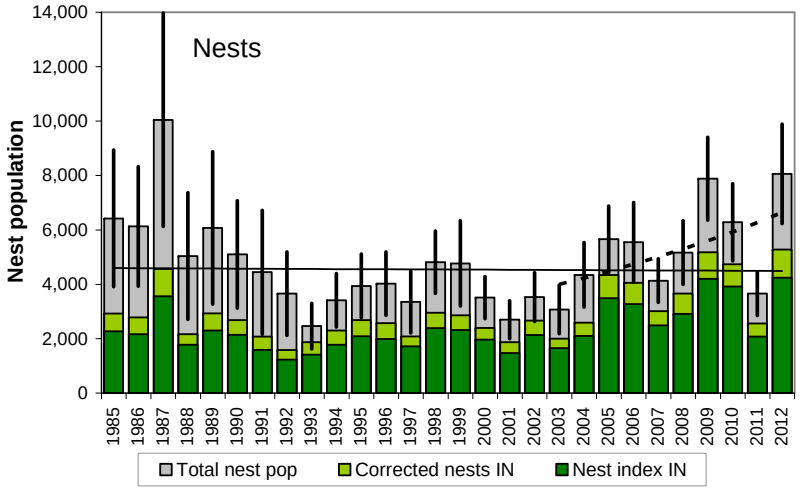
1985-2012 avg annual growth rate= 1.013 (90%c.i.= 1.000-1.026)
2003-2012 avg annual growth rate= 1.004 (90%c.i.= 0.974-1.036)



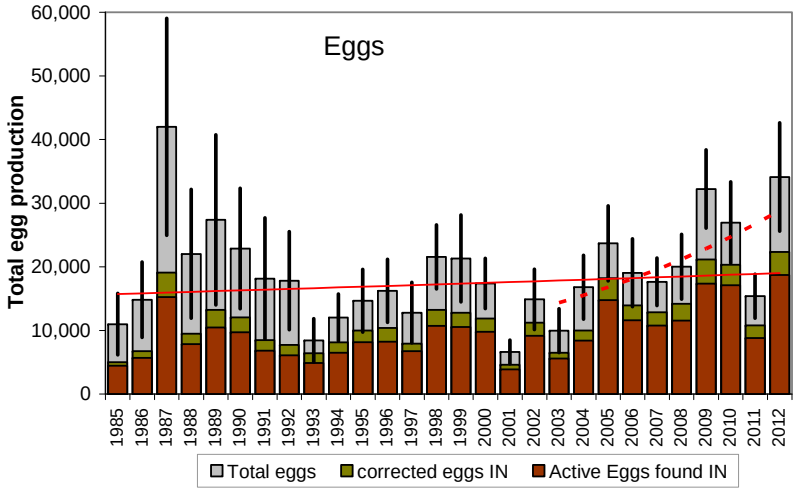
1985-2012 avg annual growth rate= 1.018 (90%c.i.= 1.003-1.034)
2003-2012 avg annual growth rate= 0.986 (90%c.i.= 0.955-1.018)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	553	145	63.3%	875	8.300	7,261	**8,136**	2,238	**10,666**	2,989	1.63	80%
1986	46	22.16	775	188	74.5%	1,040	8.300	8,634	**9,674**	2,385	**11,127**	2,933	1.48	78%
1987	37	12.67	904	192	62.8%	1,439	9.155	13,172	**14,610**	3,368	**23,060**	5,430	1.58	100%
1988	32	10.48	1,093	220	67.2%	1,627	7.901	12,855	**14,482**	3,296	**28,965**	6,592	2.14	94%
1989	23	7.45	385	178	73.2%	526	13.234	6,955	**7,481**	3,391	**14,962**	6,781	2.00	100%
1990	33	10.70	1,606	305	59.5%	2,696	9.673	26,080	**28,777**	6,605	**48,875**	11,873	1.79	95%
1991	36	11.66	982	222	72.8%	1,350	9.846	13,295	**14,645**	3,579	**27,740**	7,024	1.89	100%
1992	42	13.39	1,283	267	68.2%	1,881	8.818	16,587	**18,468**	3,984	**30,904**	6,654	1.75	96%
1993	47	15.23	893	227	51.8%	1,723	8.569	14,766	**16,489**	4,137	**24,218**	6,012	1.67	88%
1994	41	13.27	1,240	254	62.0%	2,001	7.422	14,854	**16,855**	3,986	**30,240**	7,508	1.79	100%
1995	50	22.56	983	154	49.1%	2,003	8.768	17,560	**19,562**	4,055	**28,993**	5,850	1.92	77%
1996	54	19.44	1,362	213	62.2%	2,191	8.705	19,074	**21,265**	3,947	**37,096**	7,028	1.88	93%
1997	72	23.31	1,044	187	59.8%	1,746	7.671	13,394	**15,140**	2,923	**26,731**	5,403	1.77	100%
1998	64	20.71	1,071	175	58.2%	1,839	11.096	20,407	**22,246**	4,676	**39,392**	8,214	1.77	100%
1999	53	16.97	633	162	44.7%	1,416	10.069	14,256	**15,672**	4,503	**17,485**	5,420	1.69	66%
2000	80	25.86	969	139	62.0%	1,563	12.791	19,991	**21,554**	3,898	**36,639**	6,767	1.84	92%
2001	81	26.23	355	111	65.4%	542	12.172	6,599	**7,141**	2,235	**10,937**	3,674	1.70	90%
2002	84	27.15	1,054	149	54.6%	1,933	12.754	24,648	**26,581**	5,324	**45,911**	9,164	2.00	86%
2003	83	26.87	1,092	155	67.9%	1,608	9.759	15,690	**17,298**	3,084	**33,073**	6,033	1.96	97%
2004	81	26.22	1,256	161	62.7%	2,003	8.416	16,856	**18,859**	3,377	**36,623**	6,491	1.94	100%
2005	83	26.87	1,145	164	58.4%	1,962	8.123	15,940	**17,902**	3,115	**33,814**	5,849	1.89	100%
2006	75	24.28	648	141	61.6%	1,052	12.023	12,646	**13,697**	3,523	**24,119**	6,604	1.76	100%
2007	79	25.58	811	147	66.8%	1,215	11.117	13,510	**14,725**	2,938	**28,983**	5,826	1.97	100%
2008	82	26.55	728	136	60.7%	1,199	11.303	13,554	**14,753**	3,260	**24,879**	5,539	1.76	96%
2009	81	26.24	1,009	143	57.0%	1,771	12.639	22,378	**24,149**	4,671	**40,043**	7,940	1.85	89%
2010	66	21.37	971	157	68.3%	1,423	12.104	17,223	**18,646**	3,822	**34,327**	7,217	1.93	95%
2011	82	26.55	890	145	55.3%	1,609	9.660	15,540	**17,149**	3,401	**28,724**	5,832	1.80	93%
2012	77	24.94	660	127	56.9%	1,159	13.009	15,080	**16,239**	4,035	**26,171**	6,438	1.88	86%

SPEI Spectacled Eider



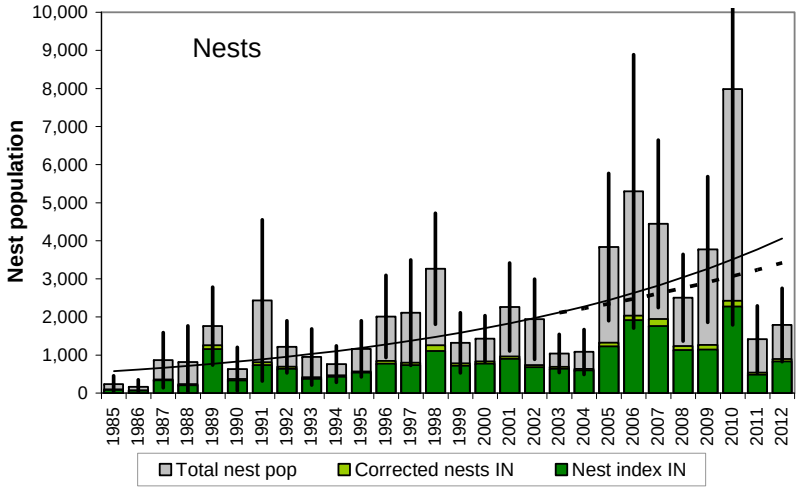
1985-2012 avg annual growth rate= 0.999 (90%c.i.= 0.986-1.012)
2003-2012 avg annual growth rate= 1.058 (90%c.i.= 1.005-1.113)



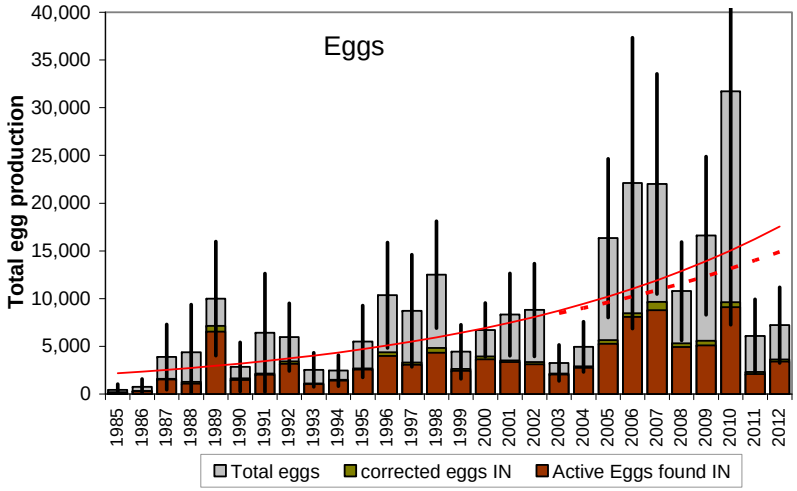
1985-2012 avg annual growth rate= 1.007 (90%c.i.= 0.991-1.023)
2003-2012 avg annual growth rate= 1.081 (90%c.i.= 1.023-1.142)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	2,272	489	77.8%	2,919	1.200	3,502	**6,422**	1,528	**10,988**	2,931	3.84	45%
1986	46	22.16	2,164	366	77.7%	2,786	1.200	3,342	**6,128**	1,337	**14,828**	3,597	4.40	55%
1987	37	12.67	3,558	758	77.9%	4,568	1.200	5,481	**10,049**	2,388	**42,015**	10,371	5.06	83%
1988	32	10.48	1,776	484	82.0%	2,166	1.325	2,871	**5,037**	1,417	**22,026**	6,159	4.81	91%
1989	23	7.45	2,307	751	78.8%	2,927	1.074	3,144	**6,071**	1,704	**27,380**	8,124	4.99	90%
1990	33	10.70	2,141	552	79.6%	2,689	0.896	2,410	**5,098**	1,201	**22,863**	5,756	5.03	89%
1991	36	11.66	1,596	491	76.9%	2,075	1.141	2,368	**4,443**	1,381	**18,150**	5,803	5.27	77%
1992	42	13.39	1,230	308	77.5%	1,587	1.307	2,075	**3,662**	932	**17,820**	4,681	5.43	90%
1993	47	15.23	1,410	348	75.3%	1,874	0.317	593	**2,467**	510	**8,430**	2,070	4.27	80%
1994	41	13.27	1,779	344	77.4%	2,300	0.483	1,110	**3,410**	598	**12,017**	2,246	4.65	76%
1995	50	22.56	2,094	417	78.0%	2,684	0.468	1,257	**3,941**	714	**14,667**	2,991	4.88	76%
1996	54	19.44	1,988	377	77.3%	2,573	0.563	1,447	**4,020**	711	**16,213**	3,013	5.06	80%
1997	72	23.31	1,719	404	82.7%	2,079	0.612	1,273	**3,353**	692	**12,791**	2,895	4.38	87%
1998	64	20.71	2,384	374	80.6%	2,956	0.629	1,858	**4,815**	699	**21,548**	3,053	4.87	92%
1999	53	16.97	2,320	532	81.0%	2,864	0.665	1,905	**4,769**	951	**21,306**	4,144	4.96	90%
2000	80	25.86	1,965	295	82.0%	2,398	0.465	1,114	**3,512**	469	**17,382**	2,407	5.34	93%
2001	81	26.23	1,474	275	78.7%	1,873	0.440	824	**2,698**	425	**6,609**	1,134	4.18	59%
2002	84	27.15	2,135	407	80.1%	2,664	0.326	868	**3,532**	547	**14,872**	2,883	5.26	80%
2003	83	26.87	1,651	350	82.7%	1,998	0.540	1,079	**3,077**	543	**9,956**	2,082	4.41	73%
2004	81	26.22	2,102	387	81.1%	2,590	0.679	1,758	**4,349**	723	**16,796**	3,051	4.97	78%
2005	83	26.87	3,489	538	80.3%	4,346	0.301	1,308	**5,654**	743	**23,682**	3,584	4.69	89%
2006	75	24.28	3,272	641	80.6%	4,061	0.366	1,485	**5,545**	889	**19,059**	3,252	4.50	76%
2007	79	25.58	2,490	340	82.7%	3,013	0.373	1,124	**4,136**	485	**17,640**	2,275	5.06	84%
2008	82	26.55	2,911	482	79.5%	3,662	0.412	1,509	**5,170**	715	**20,017**	3,089	5.04	77%
2009	81	26.24	4,201	576	81.2%	5,176	0.523	2,707	**7,883**	928	**32,227**	3,752	4.50	91%
2010	66	21.37	3,919	646	82.8%	4,735	0.327	1,547	**6,282**	863	**26,946**	3,883	4.98	86%
2011	82	26.55	2,076	329	81.0%	2,562	0.427	1,094	**3,655**	487	**15,376**	2,107	4.77	88%
2012	77	24.94	4,247	757	80.5%	5,278	0.527	2,783	**8,062**	1,110	**34,111**	5,174	4.98	85%

COEI Common Eider



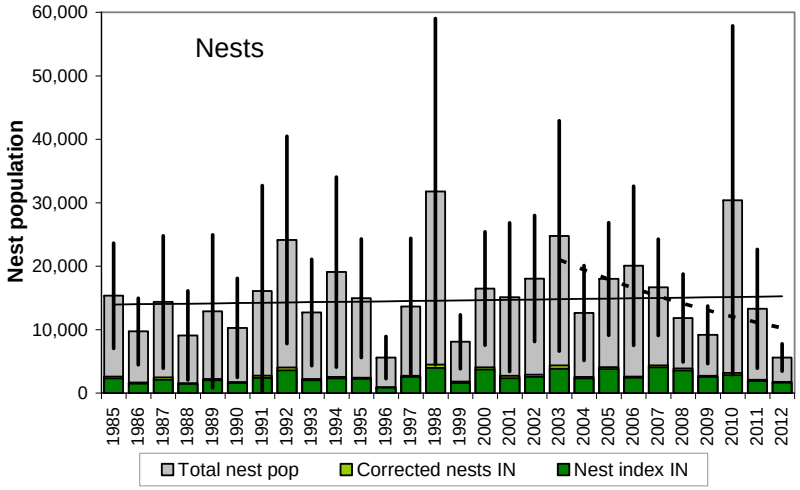
1985-2012 avg annual growth rate= 1.075 (90%c.i.= 1.050-1.101)
2003-2012 avg annual growth rate= 1.055 (90%c.i.= 0.925-1.203)



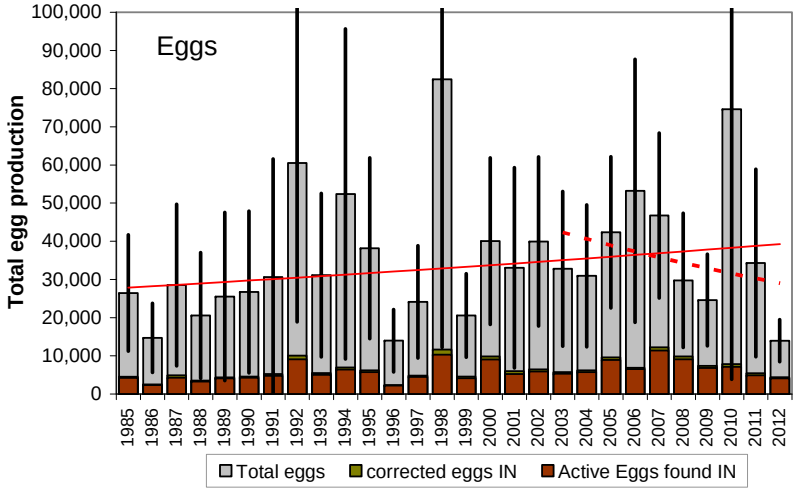
1985-2012 avg annual growth rate= 1.081 (90%c.i.= 1.051-1.111)
2003-2012 avg annual growth rate= 1.065 (90%c.i.= 0.926-1.224)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	87	47	90.2%	97	1.422	138	**235**	133	**431**	373	6.00	31%
1986	46	22.16	65	45	94.2%	69	1.422	98	**166**	111	**751**	503	4.52	100%
1987	37	12.67	339	152	94.7%	358	1.422	509	**866**	442	**3,877**	2,077	5.41	83%
1988	32	10.48	205	150	86.3%	237	2.442	580	**817**	576	**4,373**	3,033	5.35	100%
1989	23	7.45	1,154	456	91.9%	1,256	0.402	504	**1,760**	622	**10,001**	3,631	5.68	100%
1990	33	10.70	335	216	91.2%	367	0.717	263	**630**	348	**2,838**	1,566	4.50	100%
1991	36	11.66	737	381	90.6%	814	1.989	1,618	**2,432**	1,288	**6,415**	3,768	4.76	55%
1992	42	13.39	642	254	91.9%	698	0.742	518	**1,217**	416	**5,959**	2,157	5.38	91%
1993	47	15.23	376	203	89.5%	420	1.258	529	**949**	448	**2,526**	1,086	4.43	60%
1994	41	13.27	431	205	92.7%	465	0.635	296	**761**	291	**2,453**	988	3.73	86%
1995	50	22.56	539	247	95.1%	567	1.047	594	**1,161**	449	**5,508**	2,287	5.08	93%
1996	54	19.44	773	271	91.4%	846	1.375	1,164	**2,010**	656	**10,354**	3,360	5.44	95%
1997	72	23.31	737	285	92.1%	800	1.641	1,312	**2,112**	842	**8,719**	3,574	4.53	91%
1998	64	20.71	1,106	299	87.7%	1,261	1.590	2,005	**3,266**	887	**12,506**	3,405	5.01	76%
1999	53	16.97	717	296	91.7%	782	0.690	539	**1,321**	481	**4,432**	1,723	4.47	75%
2000	80	25.86	775	212	92.6%	837	0.705	590	**1,427**	368	**6,712**	1,715	4.90	96%
2001	81	26.23	900	292	93.6%	962	1.352	1,300	**2,262**	704	**8,317**	2,627	4.10	90%
2002	84	27.15	685	191	92.6%	740	1.625	1,203	**1,943**	640	**8,800**	2,957	4.72	96%
2003	83	26.87	639	225	92.9%	688	0.512	352	**1,040**	307	**3,256**	1,141	4.28	73%
2004	81	26.22	600	212	94.3%	637	0.699	445	**1,082**	359	**4,940**	1,602	4.80	95%
2005	83	26.87	1,225	298	92.4%	1,325	1.893	2,509	**3,835**	1,177	**16,331**	5,050	4.93	86%
2006	75	24.28	1,916	751	94.4%	2,030	1.610	3,268	**5,298**	2,182	**22,107**	9,269	4.81	87%
2007	79	25.58	1,763	540	90.5%	1,948	1.281	2,496	**4,444**	1,338	**22,016**	7,018	5.22	95%
2008	82	26.55	1,132	329	91.9%	1,232	1.032	1,271	**2,504**	693	**10,787**	3,135	4.82	89%
2009	81	26.24	1,146	295	90.5%	1,266	1.979	2,506	**3,772**	1,162	**16,601**	5,040	4.91	90%
2010	66	21.37	2,278	976	93.8%	2,428	2.290	5,560	**7,988**	3,767	**31,729**	14,878	4.86	82%
2011	82	26.55	485	146	90.5%	536	1.640	880	**1,416**	533	**6,087**	2,331	4.89	88%
2012	77	24.94	832	316	92.6%	898	0.990	889	**1,788**	586	**7,213**	2,406	4.59	88%

GLGU Glaucous Gull



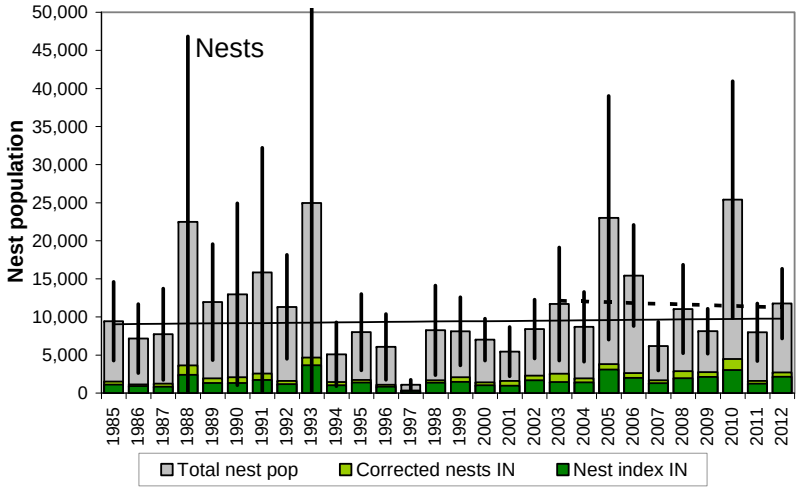
1985-2012 avg annual growth rate= 1.003 (90%c.i.= 0.987-1.020)
2003-2012 avg annual growth rate= 0.924 (90%c.i.= 0.850-1.003)



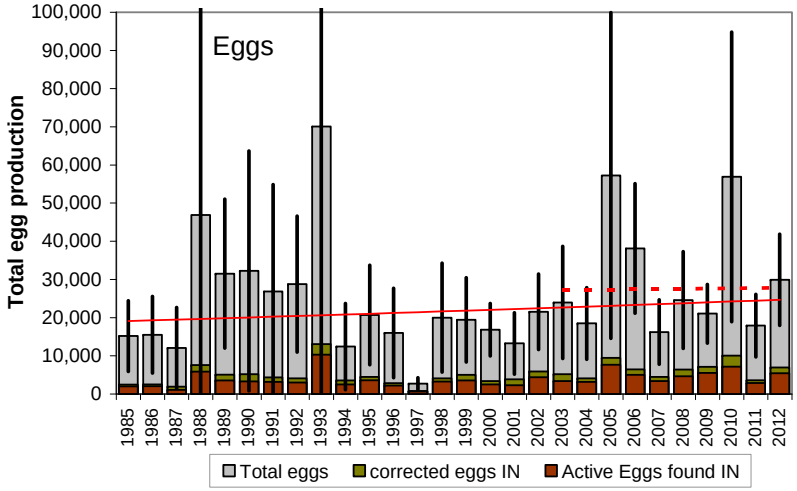
1985-2012 avg annual growth rate= 1.013 (90%c.i.= 0.995-1.030)
2003-2012 avg annual growth rate= 0.959 (90%c.i.= 0.881-1.044)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	2,330	487	88.8%	2,625	4.844	12,715	**15,340**	5,043	**26,437**	9,264	2.08	83%
1986	46	22.16	1,486	316	89.3%	1,663	4.844	8,057	**9,720**	3,185	**14,722**	5,510	2.15	70%
1987	37	12.67	2,089	766	85.0%	2,457	4.844	11,901	**14,359**	6,352	**28,538**	12,864	2.15	93%
1988	32	10.48	1,434	622	92.2%	1,556	4.844	7,536	**9,092**	4,271	**20,598**	10,017	2.53	89%
1989	23	7.45	2,019	1,106	91.4%	2,208	4.844	10,693	**12,901**	7,325	**25,526**	13,396	2.27	87%
1990	33	10.70	1,606	689	91.3%	1,758	4.844	8,515	**10,273**	4,737	**26,741**	12,891	2.91	90%
1991	36	11.66	2,395	1,501	86.9%	2,754	4.844	13,340	**16,094**	10,090	**30,666**	18,772	2.99	64%
1992	42	13.39	3,582	1,211	88.9%	4,027	4.992	20,105	**24,132**	9,930	**60,560**	25,328	2.71	92%
1993	47	15.23	2,021	703	90.7%	2,228	4.695	10,462	**12,690**	5,100	**31,152**	13,025	2.53	97%
1994	41	13.27	2,319	1,103	91.6%	2,532	6.538	16,555	**19,087**	9,102	**52,398**	26,289	2.83	97%
1995	50	22.56	2,252	643	92.8%	2,428	5.154	12,512	**14,940**	5,674	**38,178**	14,398	2.56	100%
1996	54	19.44	884	241	94.0%	940	4.965	4,666	**5,606**	2,022	**13,971**	4,984	2.49	100%
1997	72	23.31	2,548	1,188	93.8%	2,716	4.023	10,924	**13,640**	6,527	**24,126**	8,958	1.79	99%
1998	64	20.71	3,939	1,749	87.6%	4,495	6.063	27,252	**31,747**	16,589	**82,465**	42,716	2.67	97%
1999	53	16.97	1,603	387	88.9%	1,804	3.487	6,290	**8,094**	2,583	**20,577**	6,657	2.72	94%
2000	80	25.86	3,709	974	91.5%	4,054	3.064	12,422	**16,475**	5,432	**40,042**	13,272	2.50	97%
2001	81	26.23	2,347	955	86.3%	2,718	4.557	12,386	**15,104**	7,117	**33,055**	15,954	2.36	93%
2002	84	27.15	2,531	580	86.7%	2,917	5.189	15,138	**18,056**	6,026	**39,955**	13,472	2.59	85%
2003	83	26.87	3,835	1,748	88.4%	4,338	4.709	20,427	**24,765**	11,030	**32,803**	12,305	1.64	81%
2004	81	26.22	2,320	717	91.5%	2,534	3.980	10,088	**12,622**	4,542	**30,963**	11,312	2.49	99%
2005	83	26.87	3,782	1,049	92.6%	4,084	3.406	13,911	**17,995**	5,397	**42,366**	12,042	2.41	98%
2006	75	24.28	2,446	742	94.1%	2,600	6.715	17,458	**20,058**	7,619	**53,238**	20,945	2.69	99%
2007	79	25.58	4,057	1,101	93.0%	4,360	2.823	12,311	**16,671**	4,610	**46,762**	13,125	2.83	99%
2008	82	26.55	3,558	1,156	91.2%	3,901	2.032	7,926	**11,828**	4,222	**29,782**	10,688	2.67	94%
2009	81	26.24	2,537	688	92.8%	2,735	2.353	6,436	**9,171**	2,754	**24,621**	7,295	2.72	99%
2010	66	21.37	2,847	1,429	88.8%	3,206	8.478	27,180	**30,386**	16,706	**74,570**	42,993	2.54	96%
2011	82	26.55	1,887	621	89.8%	2,102	5.321	11,186	**13,288**	5,700	**34,363**	14,931	2.63	98%
2012	77	24.94	1,636	293	92.5%	1,769	2.165	3,830	**5,598**	1,312	**13,965**	3,369	2.60	96%

MEGU Mew Gull



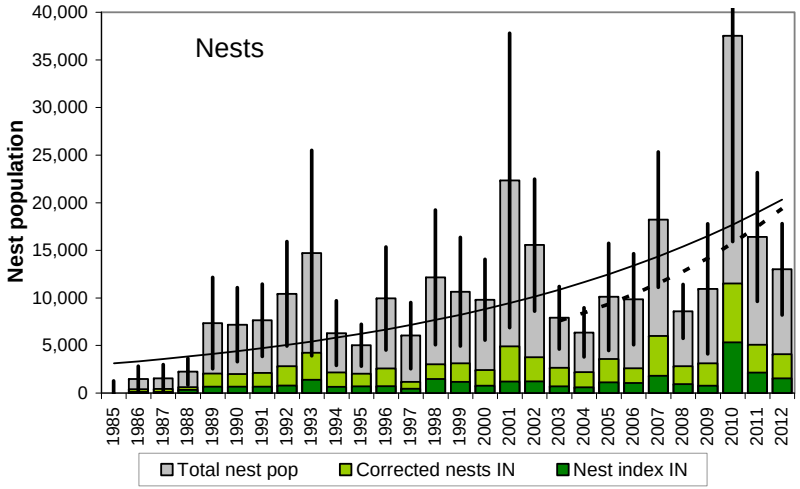
1985-2012 avg annual growth rate= 1.003 (90%c.i.= 0.979-1.027)
2003-2012 avg annual growth rate= 0.992 (90%c.i.= 0.908-1.083)



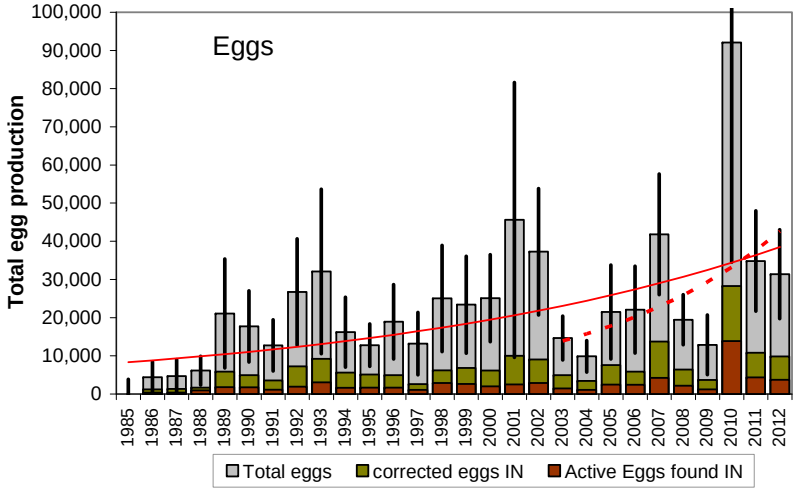
1985-2012 avg annual growth rate= 1.010 (90%c.i.= 0.985-1.034)
2003-2012 avg annual growth rate= 1.002 (90%c.i.= 0.918-1.095)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN	Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	1,107	270	72.6%	1,525		5.191	7,915	**9,439**	3,152	**15,181**	5,645	1.95	82%
1986	46	22.16	937	286	80.9%	1,157		5.191	6,008	**7,166**	2,749	**15,529**	6,103	2.29	95%
1987	37	12.67	847	385	67.8%	1,249		5.191	6,483	**7,732**	3,653	**12,073**	6,467	1.56	100%
1988	32	10.48	2,390	1,793	65.9%	3,629		5.191	18,840	**22,469**	14,808	**46,912**	34,371	2.47	85%
1989	23	7.45	1,346	385	69.7%	1,930		5.191	10,017	**11,946**	4,634	**31,522**	11,864	2.64	100%
1990	33	10.70	1,338	814	63.9%	2,095		5.191	10,873	**12,968**	7,265	**32,282**	19,094	2.68	93%
1991	36	11.66	1,719	1,037	67.1%	2,562		5.191	13,302	**15,865**	9,935	**26,875**	17,015	2.37	72%
1992	42	13.39	1,176	323	72.9%	1,612		6.025	9,715	**11,327**	4,148	**28,795**	10,818	2.69	95%
1993	47	15.23	3,667	2,931	78.7%	4,661		4.358	20,309	**24,970**	17,627	**70,045**	49,845	2.81	100%
1994	41	13.27	1,024	547	70.7%	1,450		2.515	3,645	**5,094**	2,544	**12,435**	6,848	2.65	92%
1995	50	22.56	1,396	403	81.2%	1,719		3.655	6,285	**8,004**	3,048	**20,713**	7,927	2.59	100%
1996	54	19.44	847	241	78.2%	1,083		4.599	4,983	**6,066**	2,622	**16,007**	7,121	2.64	100%
1997	72	23.31	276	85	85.6%	323		2.416	780	**1,103**	387	**2,707**	974	2.45	100%
1998	64	20.71	1,348	446	80.0%	1,685		3.892	6,558	**8,244**	3,577	**20,000**	8,690	2.43	100%
1999	53	16.97	1,476	399	70.7%	2,089		2.877	6,011	**8,101**	2,724	**19,413**	6,720	2.48	97%
2000	80	25.86	1,024	189	72.4%	1,414		3.967	5,610	**7,024**	1,673	**16,840**	4,169	2.59	93%
2001	81	26.23	982	300	61.8%	1,588		2.428	3,857	**5,446**	1,973	**13,252**	4,905	2.43	100%
2002	84	27.15	1,687	378	73.2%	2,305		2.645	6,098	**8,403**	2,351	**21,531**	6,017	2.68	96%
2003	83	26.87	1,465	387	57.8%	2,535		3.612	9,159	**11,694**	4,516	**23,961**	8,933	2.58	79%
2004	81	26.22	1,419	326	73.4%	1,934		3.498	6,765	**8,699**	2,780	**18,505**	5,697	2.45	87%
2005	83	26.87	3,090	1,366	81.0%	3,813		5.035	19,202	**23,015**	9,725	**57,251**	25,942	2.49	100%
2006	75	24.28	2,004	507	76.4%	2,623		4.884	12,813	**15,437**	4,030	**38,157**	10,306	2.47	100%
2007	79	25.58	1,287	252	75.5%	1,705		2.614	4,458	**6,163**	1,941	**16,237**	5,134	2.63	100%
2008	82	26.55	1,968	520	68.7%	2,866		2.854	8,178	**11,043**	3,529	**24,629**	7,698	2.49	90%
2009	81	26.24	2,128	370	77.2%	2,755		1.948	5,368	**8,124**	1,796	**21,039**	4,680	2.65	98%
2010	66	21.37	3,015	960	67.1%	4,489		4.657	20,908	**25,397**	9,451	**56,889**	23,053	2.56	87%
2011	82	26.55	1,240	261	77.2%	1,605		3.977	6,385	**7,990**	2,299	**17,918**	4,999	2.33	96%
2012	77	24.94	2,152	423	78.6%	2,737		3.297	9,024	**11,761**	2,782	**29,946**	7,270	2.55	100%

SAGU Sabine's Gull



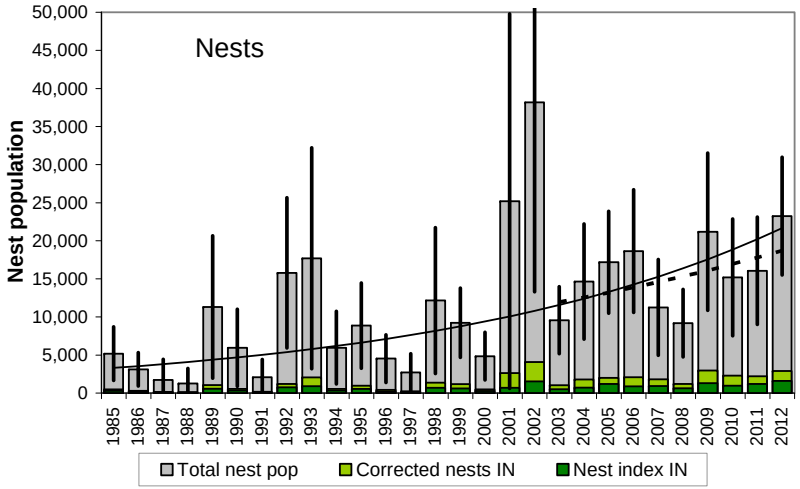
1985-2012 avg annual growth rate= 1.072 (90%c.i.= 1.049-1.095)
2003-2012 avg annual growth rate= 1.110 (90%c.i.= 1.028-1.199)



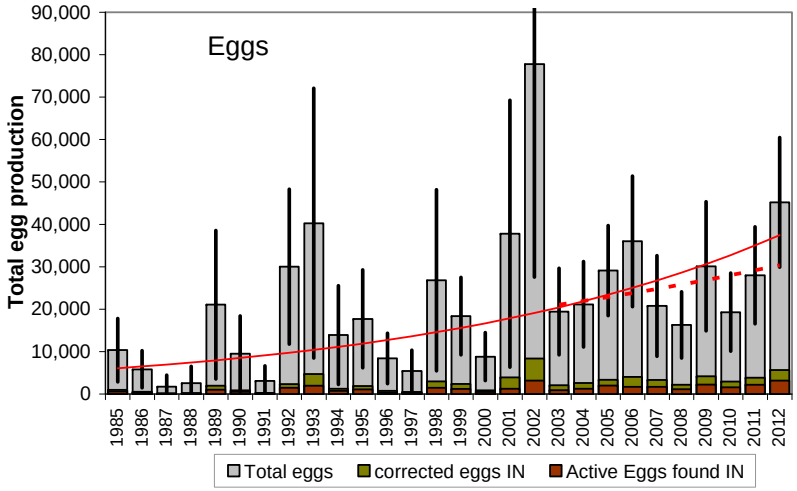
1985-2012 avg annual growth rate= 1.058 (90%c.i.= 1.036-1.082)
2003-2012 avg annual growth rate= 1.133 (90%c.i.= 1.023-1.254)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	OUT:IN	Aerial ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	0	78		0		2.581	0	**0**	783	**0**	2,350		
1986	46	22.16	129	78	31.5%	410		2.581	1,058	**1,468**	821	**4,405**	2,464	3.00	100%
1987	37	12.67	113	76	25.9%	436		2.581	1,125	**1,561**	871	**4,681**	2,614	3.00	100%
1988	32	10.48	341	142	54.3%	628		2.581	1,622	**2,250**	849	**6,126**	2,275	2.72	100%
1989	23	7.45	673	291	32.8%	2,053		2.581	5,300	**7,353**	2,917	**21,064**	8,676	2.86	100%
1990	33	10.70	669	223	33.3%	2,007		2.581	5,180	**7,187**	2,368	**17,724**	5,679	2.47	100%
1991	36	11.66	675	192	31.6%	2,134		2.581	5,509	**7,643**	2,312	**12,723**	4,079	1.66	100%
1992	42	13.39	802	291	28.3%	2,833		2.680	7,592	**10,425**	3,343	**26,736**	8,469	2.56	100%
1993	47	15.23	1,410	724	33.4%	4,225		2.482	10,487	**14,712**	6,556	**32,109**	13,088	2.41	91%
1994	41	13.27	647	220	29.7%	2,179		1.892	4,123	**6,302**	2,069	**16,207**	5,561	2.57	100%
1995	50	22.56	698	185	34.5%	2,024		1.486	3,009	**5,033**	1,341	**12,772**	3,378	2.54	100%
1996	54	19.44	736	216	28.4%	2,591		2.834	7,344	**9,935**	3,293	**18,924**	5,912	2.42	79%
1997	72	23.31	460	136	38.5%	1,196		4.048	4,843	**6,039**	2,115	**13,196**	4,969	2.18	100%
1998	64	20.71	1,486	720	49.1%	3,026		3.018	9,132	**12,159**	4,307	**25,018**	8,463	2.06	100%
1999	53	16.97	1,181	560	37.9%	3,113		2.421	7,536	**10,648**	3,477	**23,394**	7,727	2.20	100%
2000	80	25.86	775	182	32.2%	2,408		3.074	7,402	**9,810**	2,588	**25,109**	6,950	2.56	100%
2001	81	26.23	1,201	423	24.4%	4,915		3.544	17,420	**22,335**	9,401	**45,608**	21,888	2.30	89%
2002	84	27.15	1,239	404	32.8%	3,774		3.120	11,776	**15,549**	4,215	**37,289**	10,066	2.40	100%
2003	83	26.87	692	186	26.1%	2,656		1.979	5,257	**7,913**	2,001	**14,667**	3,489	2.18	85%
2004	81	26.22	600	148	27.3%	2,199		1.897	4,172	**6,371**	1,566	**9,889**	2,508	1.99	78%
2005	83	26.87	1,145	256	32.0%	3,579		1.824	6,529	**10,108**	3,420	**21,495**	7,494	2.13	100%
2006	75	24.28	1,061	372	40.6%	2,616		2.766	7,236	**9,853**	2,907	**22,111**	6,918	2.24	100%
2007	79	25.58	1,819	398	30.4%	5,992		2.041	12,230	**18,222**	4,323	**41,809**	9,622	2.29	100%
2008	82	26.55	944	151	33.5%	2,819		2.046	5,768	**8,588**	1,720	**19,461**	3,969	2.27	100%
2009	81	26.24	764	187	24.4%	3,130		2.497	7,817	**10,947**	4,155	**12,882**	4,760	1.76	67%
2010	66	21.37	5,326	3,366	46.2%	11,524		2.256	25,999	**37,523**	13,128	**92,069**	35,001	2.56	96%
2011	82	26.55	2,156	830	42.4%	5,091		2.220	11,305	**16,397**	4,109	**34,847**	7,970	2.22	96%
2012	77	24.94	1,550	383	37.9%	4,085		2.185	8,925	**13,010**	2,915	**31,380**	7,074	2.41	100%

ARTE Arctic Tern



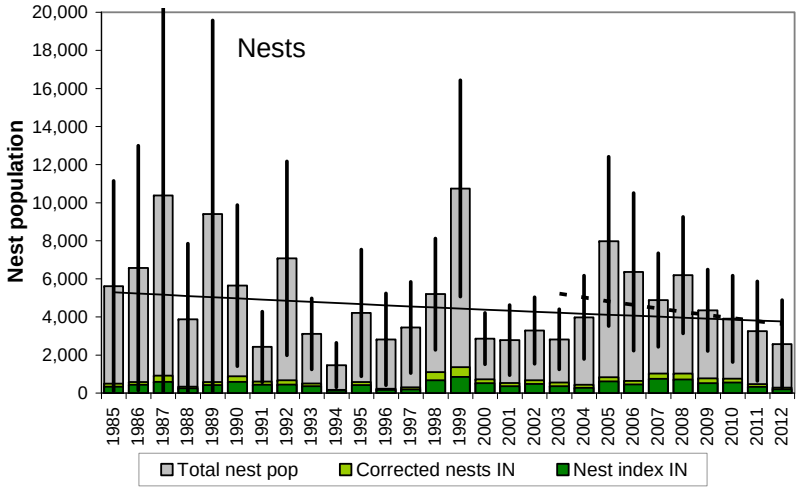
1985-2012 avg annual growth rate= 1.072 (90%c.i.= 1.045-1.100)
2003-2012 avg annual growth rate= 1.051 (90%c.i.= 0.996-1.109)



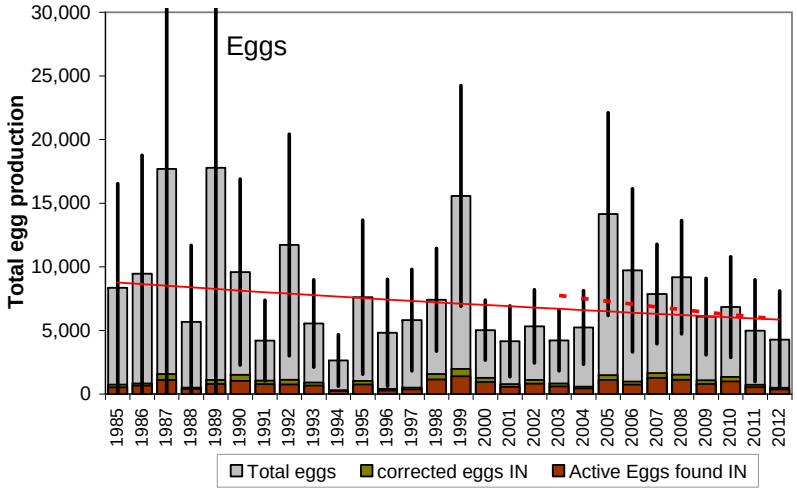
1985-2012 avg annual growth rate= 1.070 (90%c.i.= 1.040-1.100)
2003-2012 avg annual growth rate= 1.042 (90%c.i.= 0.984-1.103)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	291	110	60.3%	483	9.726	4,695	**5,177**	2,140	**10,355**	4,529	2.00	100%
1986	46	22.16	194	77	66.6%	291	9.726	2,832	**3,123**	1,335	**5,831**	2,669	1.87	100%
1987	37	12.67	113	112	70.1%	161	9.726	1,566	**1,727**	1,647	**1,727**	1,647	1.00	100%
1988	32	10.48	68	68	57.9%	118	9.726	1,147	**1,264**	1,207	**2,529**	2,413	2.00	100%
1989	23	7.45	577	284	54.7%	1,054	9.726	10,248	**11,301**	5,684	**21,055**	10,658	1.86	100%
1990	33	10.70	335	168	60.3%	554	9.726	5,391	**5,946**	3,078	**9,513**	5,422	1.60	100%
1991	36	11.66	123	85	63.3%	194	9.726	1,886	**2,080**	1,419	**3,069**	2,174	1.48	100%
1992	42	13.39	748	235	61.1%	1,225	11.886	14,557	**15,782**	5,991	**30,033**	11,084	1.90	100%
1993	47	15.23	893	482	43.2%	2,066	7.567	15,630	**17,696**	8,817	**40,266**	19,339	2.28	100%
1994	41	13.27	323	163	59.5%	544	9.990	5,430	**5,973**	2,895	**13,911**	7,065	2.33	100%
1995	50	22.56	539	165	56.1%	961	8.226	7,902	**8,862**	3,402	**17,724**	7,011	2.00	100%
1996	54	19.44	221	85	52.5%	421	9.757	4,103	**4,524**	1,903	**8,392**	3,628	1.86	100%
1997	72	23.31	154	78	64.6%	238	10.407	2,472	**2,710**	1,497	**5,419**	2,994	2.00	100%
1998	64	20.71	691	193	51.3%	1,348	8.013	10,798	**12,146**	5,816	**26,828**	12,973	2.21	100%
1999	53	16.97	591	170	49.6%	1,190	6.756	8,039	**9,229**	2,768	**18,358**	5,543	1.99	100%
2000	80	25.86	277	90	58.6%	473	9.253	4,372	**4,844**	1,902	**8,825**	3,450	1.82	100%
2001	81	26.23	682	269	26.0%	2,623	8.605	22,568	**25,190**	14,950	**37,812**	19,126	1.92	78%
2002	84	27.15	1,529	434	37.4%	4,091	8.330	34,080	**38,172**	15,117	**77,797**	30,528	2.04	100%
2003	83	26.87	506	136	49.2%	1,028	8.306	8,537	**9,565**	2,678	**19,442**	6,215	2.03	100%
2004	81	26.22	737	137	41.2%	1,789	7.183	12,851	**14,640**	4,595	**21,152**	6,135	1.77	82%
2005	83	26.87	1,199	258	60.4%	1,985	7.655	15,197	**17,182**	4,061	**29,096**	6,463	1.69	100%
2006	75	24.28	884	175	42.4%	2,087	7.935	16,558	**18,645**	4,903	**35,987**	9,352	1.93	100%
2007	79	25.58	923	169	51.1%	1,806	5.231	9,446	**11,252**	3,821	**20,788**	7,218	1.85	100%
2008	82	26.55	647	170	53.4%	1,213	6.572	7,970	**9,182**	2,696	**16,288**	4,743	1.77	100%
2009	81	26.24	1,309	463	44.3%	2,956	6.166	18,228	**21,184**	6,284	**30,114**	9,260	1.75	81%
2010	66	21.37	971	216	42.1%	2,305	5.595	12,894	**15,198**	4,657	**19,298**	5,595	1.74	73%
2011	82	26.55	1,213	244	55.2%	2,199	6.305	13,865	**16,064**	4,281	**27,997**	6,941	1.84	95%
2012	77	24.94	1,607	243	55.4%	2,900	7.016	20,344	**23,244**	4,692	**45,182**	9,286	1.94	100%

RTLO Red-throated Loon



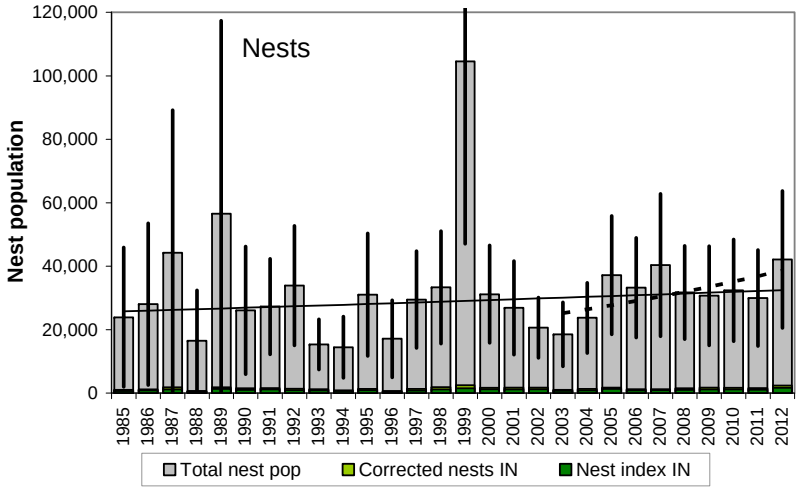
1985-2012 avg annual growth rate= 0.987 (90%c.i.= 0.969-1.006)
2003-2012 avg annual growth rate= 0.960 (90%c.i.= 0.899-1.026)



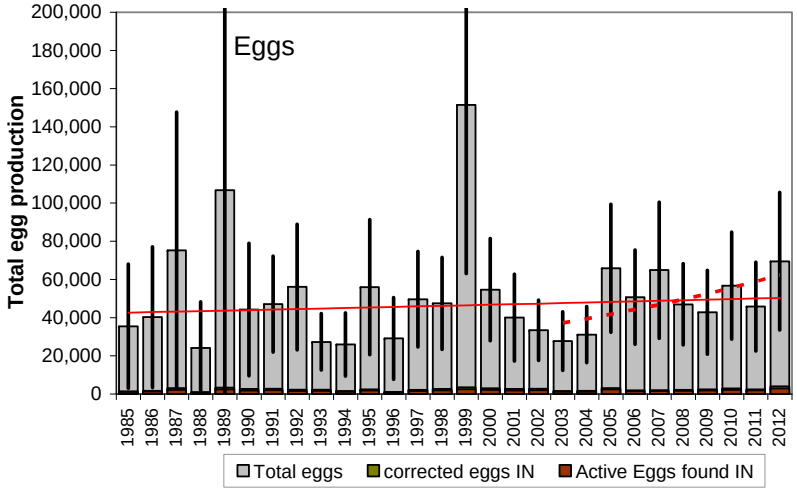
1985-2012 avg annual growth rate= 0.985 (90%c.i.= 0.967-1.003)
2003-2012 avg annual growth rate= 0.969 (90%c.i.= 0.901-1.043)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	344	149	68.7%	500	10.242	5,119	**5,618**	3,359	**8,345**	4,977	1.64	90%
1986	46	22.16	435	189	74.4%	585	10.242	5,990	**6,575**	3,906	**9,459**	5,650	1.64	88%
1987	37	12.67	590	276	63.9%	924	10.242	9,459	**10,383**	6,784	**17,692**	11,003	1.95	88%
1988	32	10.48	253	121	73.5%	344	10.242	3,528	**3,873**	2,419	**5,661**	3,653	1.66	88%
1989	23	7.45	426	229	72.9%	584	15.093	8,820	**9,405**	6,187	**17,773**	11,715	1.89	100%
1990	33	10.70	588	243	66.6%	883	5.391	4,762	**5,645**	2,572	**9,586**	4,437	1.82	93%
1991	36	11.66	433	180	71.9%	603	3.033	1,828	**2,431**	1,129	**4,199**	1,922	1.86	93%
1992	42	13.39	453	162	66.8%	678	9.441	6,403	**7,081**	3,098	**11,717**	5,295	1.86	89%
1993	47	15.23	365	123	71.8%	508	5.125	2,602	**3,110**	1,129	**5,545**	2,083	1.92	93%
1994	41	13.27	129	58	77.2%	168	7.764	1,302	**1,469**	711	**2,640**	1,233	1.80	100%
1995	50	22.56	420	165	73.0%	575	6.324	3,638	**4,213**	2,022	**7,609**	3,680	1.81	100%
1996	54	19.44	164	69	71.6%	229	11.351	2,596	**2,825**	1,465	**4,817**	2,556	1.71	100%
1997	72	23.31	192	64	63.7%	301	10.455	3,145	**3,446**	1,455	**5,812**	2,420	1.91	88%
1998	64	20.71	677	204	61.5%	1,100	3.724	4,097	**5,198**	1,777	**7,412**	2,453	1.87	76%
1999	53	16.97	845	229	61.8%	1,367	6.863	9,380	**10,746**	3,453	**15,568**	5,276	1.81	80%
2000	80	25.86	514	134	71.2%	722	2.961	2,138	**2,860**	822	**5,021**	1,437	1.89	93%
2001	81	26.23	361	126	68.4%	528	4.271	2,253	**2,781**	1,116	**4,147**	1,699	1.62	92%
2002	84	27.15	487	140	71.7%	680	3.834	2,607	**3,286**	1,063	**5,324**	1,753	1.72	94%
2003	83	26.87	367	115	66.4%	553	4.103	2,268	**2,821**	960	**4,224**	1,455	1.73	86%
2004	81	26.22	283	76	64.9%	436	8.129	3,548	**3,985**	1,332	**5,234**	1,766	1.72	76%
2005	83	26.87	623	175	74.8%	833	8.571	7,136	**7,969**	2,701	**14,141**	4,844	1.81	98%
2006	75	24.28	462	142	72.0%	642	8.925	5,727	**6,369**	2,516	**9,726**	3,898	1.72	89%
2007	79	25.58	752	203	73.4%	1,023	3.776	3,864	**4,888**	1,491	**7,857**	2,379	1.74	92%
2008	82	26.55	712	183	69.2%	1,029	5.020	5,163	**6,192**	1,861	**9,179**	2,711	1.64	91%
2009	81	26.24	517	134	66.3%	780	4.579	3,570	**4,350**	1,301	**6,078**	1,825	1.73	81%
2010	66	21.37	551	174	72.3%	762	4.121	3,141	**3,903**	1,376	**6,835**	2,407	1.85	95%
2011	82	26.55	323	111	69.0%	468	5.957	2,788	**3,256**	1,587	**4,980**	2,430	1.84	83%
2012	77	24.94	205	81	69.9%	294	7.793	2,288	**2,581**	1,401	**4,266**	2,326	1.83	90%

PALO Pacific Loon



1985-2012 avg annual growth rate= 1.009 (90%c.i.= 0.993-1.025)
2003-2012 avg annual growth rate= 1.049 (90%c.i.= 1.010-1.090)



1985-2012 avg annual growth rate= 1.006 (90%c.i.= 0.990-1.023)
2003-2012 avg annual growth rate= 1.059 (90%c.i.= 1.008-1.112)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Corrected % nest success index
1985	49	24.57	676	283	68.7%	984	23.321	22,936	**23,920**	13,337	**35,528**	19,749	1.64	90%
1986	46	22.16	857	358	74.4%	1,151	23.321	26,840	**27,991**	15,488	**40,271**	22,427	1.64	88%
1987	37	12.67	1,161	525	63.9%	1,818	23.321	42,387	**44,204**	27,337	**75,319**	43,990	1.95	88%
1988	32	10.48	498	231	73.5%	678	23.321	15,809	**16,487**	9,678	**24,102**	14,691	1.66	88%
1989	23	7.45	1,304	706	72.9%	1,789	30.597	54,751	**56,540**	36,923	**106,852**	69,927	1.89	100%
1990	33	10.70	1,018	414	66.6%	1,528	16.045	24,523	**26,051**	12,228	**44,238**	21,127	1.82	93%
1991	36	11.66	1,163	352	71.9%	1,617	15.857	25,647	**27,265**	9,150	**47,093**	15,297	1.86	93%
1992	42	13.39	937	285	66.8%	1,402	23.174	32,482	**33,884**	11,457	**56,069**	20,006	1.86	89%
1993	47	15.23	905	274	71.8%	1,260	11.160	14,064	**15,324**	4,799	**27,320**	8,990	1.92	93%
1994	41	13.27	679	276	77.2%	880	15.429	13,579	**14,459**	5,881	**25,978**	10,033	1.80	100%
1995	50	22.56	976	312	73.0%	1,337	22.194	29,676	**31,013**	11,746	**56,014**	21,502	1.81	100%
1996	54	19.44	462	177	71.6%	645	25.534	16,468	**17,113**	7,397	**29,179**	13,033	1.71	100%
1997	72	23.31	821	223	63.7%	1,289	21.841	28,152	**29,441**	9,268	**49,654**	15,239	1.91	88%
1998	64	20.71	1,154	307	61.5%	1,876	16.753	31,437	**33,313**	10,776	**47,505**	14,666	1.87	76%
1999	53	16.97	1,517	421	61.8%	2,454	41.593	102,080	**104,534**	34,941	**151,443**	53,702	1.81	80%
2000	80	25.86	1,202	299	71.2%	1,687	17.469	29,479	**31,167**	9,325	**54,720**	16,287	1.89	93%
2001	81	26.23	1,194	341	68.4%	1,745	14.381	25,096	**26,842**	8,953	**40,032**	13,816	1.62	92%
2002	84	27.15	1,226	297	71.7%	1,711	11.046	18,905	**20,617**	5,771	**33,398**	9,615	1.72	94%
2003	83	26.87	698	202	66.4%	1,052	16.595	17,465	**18,517**	6,133	**27,727**	9,325	1.73	86%
2004	81	26.22	836	202	64.9%	1,287	17.427	22,428	**23,715**	6,738	**31,149**	8,972	1.72	76%
2005	83	26.87	1,322	329	74.8%	1,767	20.019	35,375	**37,142**	11,345	**65,908**	20,422	1.81	98%
2006	75	24.28	894	227	72.0%	1,241	25.778	31,991	**33,232**	9,556	**50,749**	15,008	1.72	89%
2007	79	25.58	927	251	73.4%	1,263	30.971	39,102	**40,365**	13,621	**64,884**	21,714	1.74	92%
2008	82	26.55	1,040	246	69.2%	1,503	20.081	30,191	**31,694**	8,953	**46,987**	12,950	1.64	91%
2009	81	26.24	1,147	298	66.3%	1,730	16.730	28,944	**30,674**	9,517	**42,866**	13,365	1.73	81%
2010	66	21.37	1,190	314	72.3%	1,646	18.691	30,758	**32,404**	9,755	**56,752**	17,046	1.85	95%
2011	82	26.55	1,106	291	69.0%	1,602	17.702	28,356	**29,958**	9,194	**45,820**	14,113	1.84	83%
2012	77	24.94	1,660	438	69.9%	2,376	16.712	39,716	**42,092**	13,107	**69,559**	21,922	1.83	90%

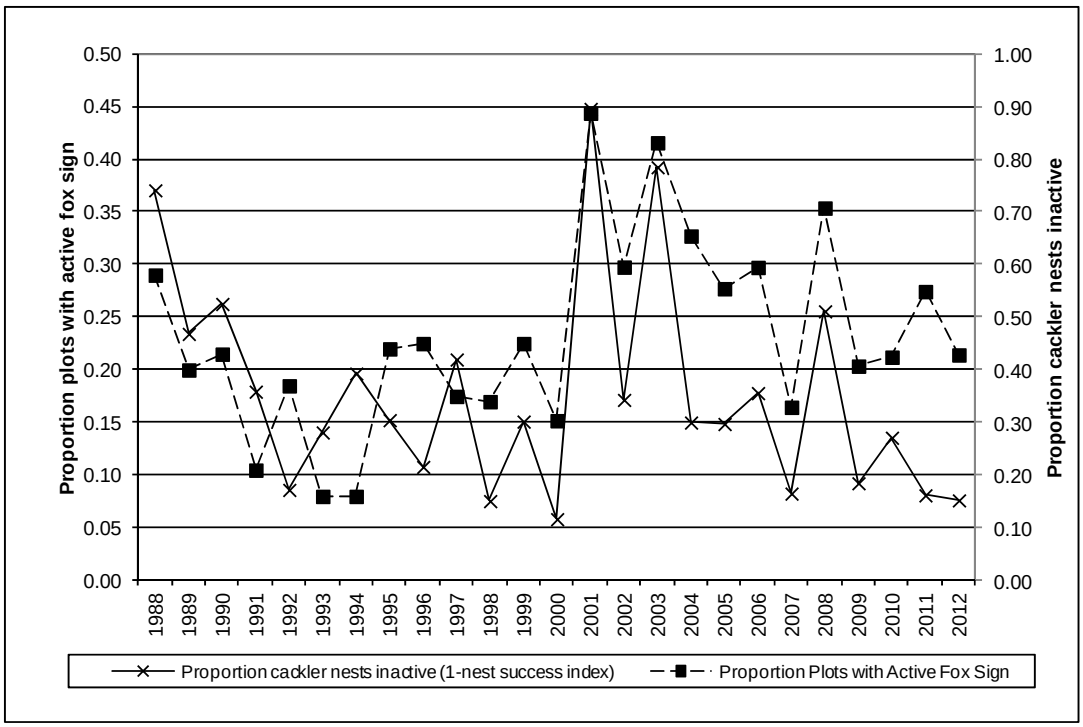


Figure 5. Trends in fox abundance (proportion of plots with observed fox, scat, fur, tracks, and/or active dens) nest failure of cackling Canada goose nests (1-nest success index).

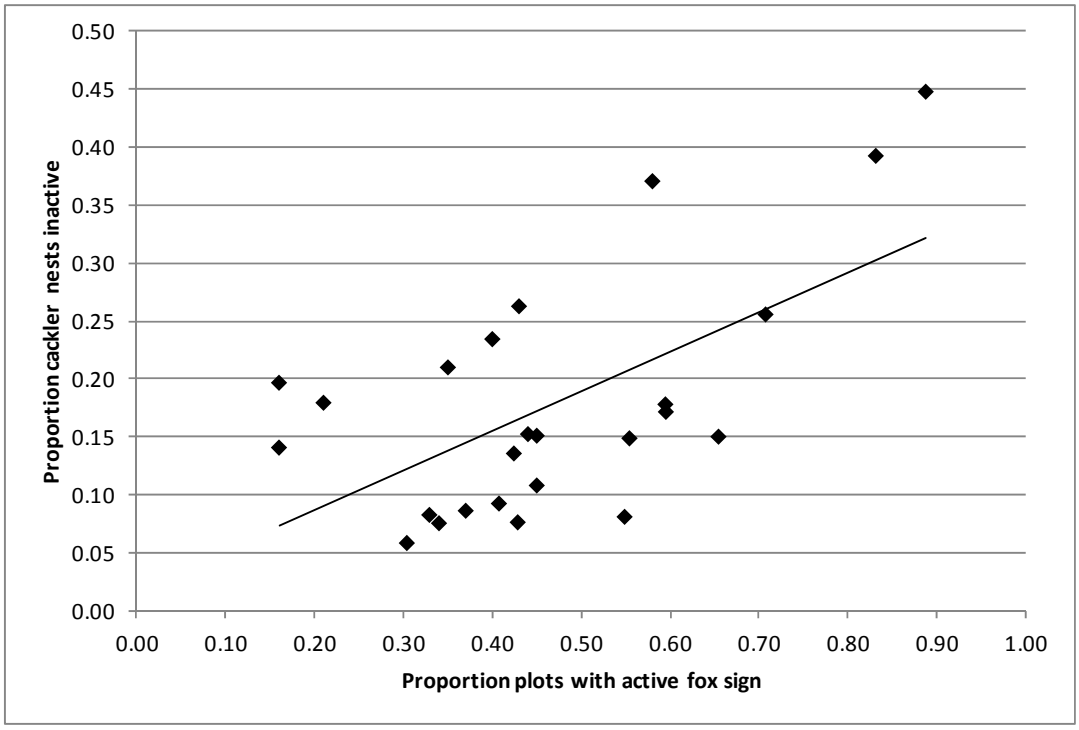


Figure 6. Relationship between fox abundance (proportion of plots with observed fox, scat, fur, tracks, and/or active dens) and cackling Canada goose nest failure (1-nest success index). Fox abundance explained 38% of the variation in nest failure. $F_{1,23} = 13.86$, $P \leq 0.001$, $R^2 = 0.38$.

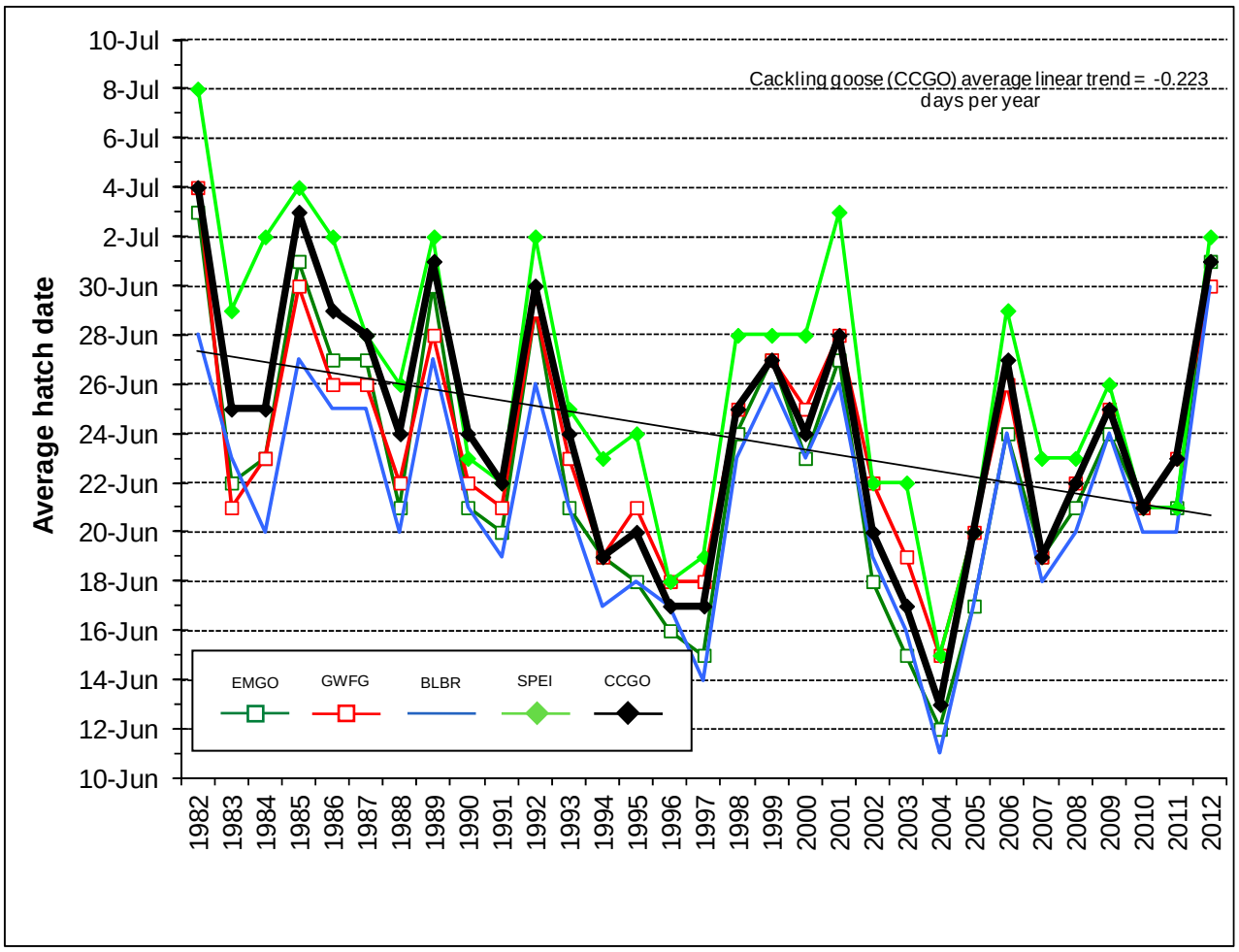


Figure 7. Estimated average hatch dates of emperor geese (EMGO), greater white-fronted geese (GWFG), black brant (BLBR), spectacled eiders (SPEI), and cackling geese (CCGO), based on egg float angles, 1982-2012. Linear regression on cackling goose hatch date indicates an average linear advance of 0.223 days per year since 1982.

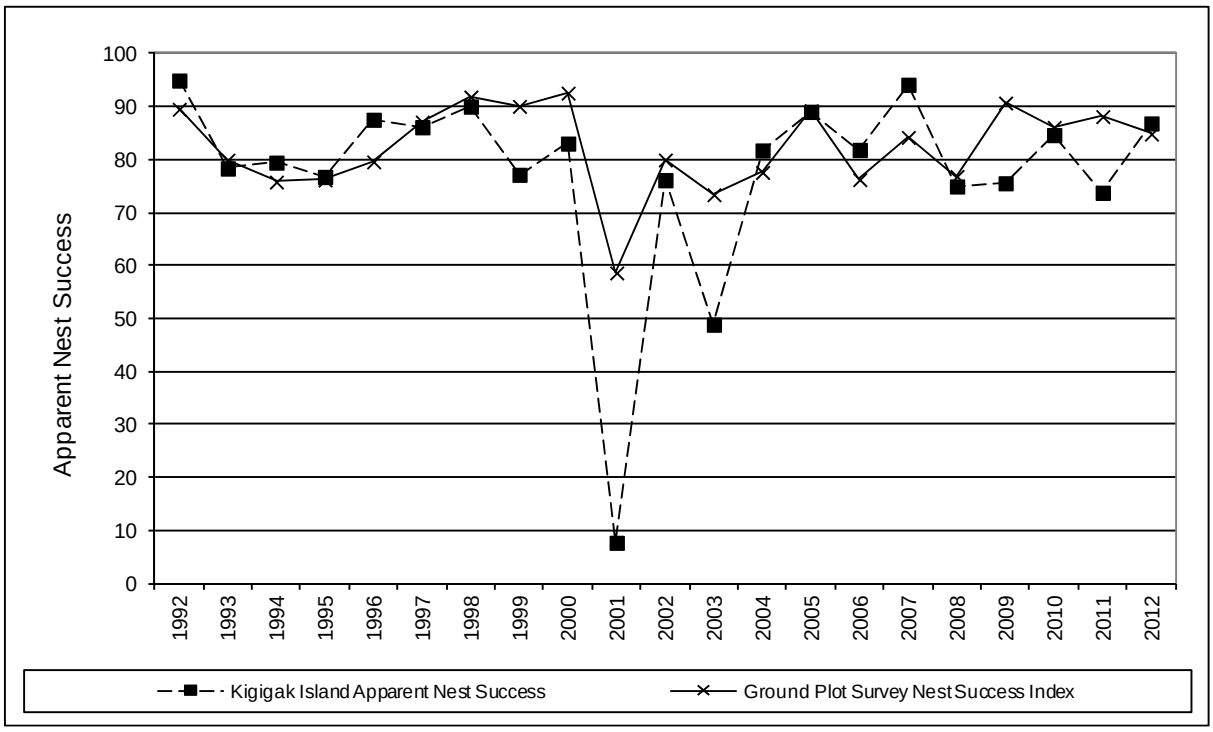


Figure 8. Comparison of spectacled eider apparent nest success measures at Kigigak Island (successful hatched nests/total nests; Gabrielson et al. 2012) and the Yukon-Kuskokwim Delta nest plot survey (active nests at time of search/total nests, corrected for nest detection rate), 1992-2012.

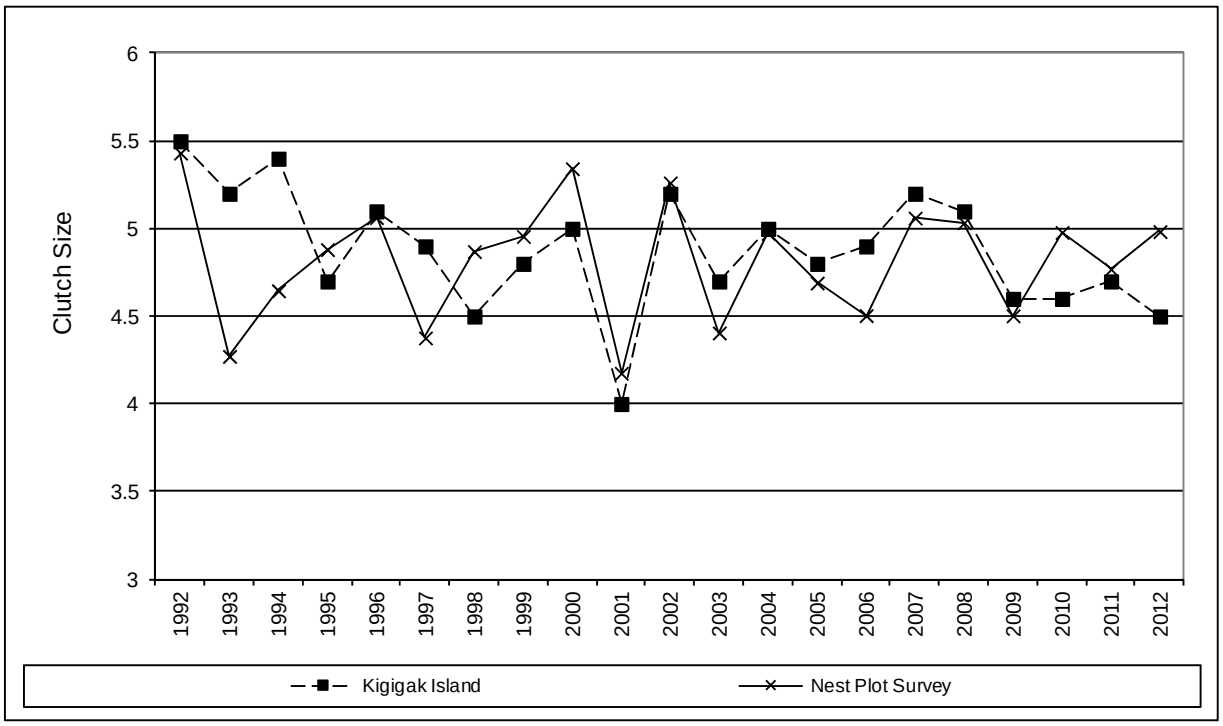


Figure 9. Comparison of spectacled eider clutch size on Kigigak Island (Gabrielson et al. 2012) and the Yukon-Kuskokwim Delta nest plot survey 1992-2012.

Table 1. Estimates used to calculate nest initiation and hatch dates: average incubation duration, laying rate (Afton and Paulus 1992, Alisauskas and Ankney 1992), and age of eggs in days per incubation stage category. See methods section for details on nest initiation and hatch date calculation procedures.

			Incubation Stage								
Species	average incubation (days)	eggs laid/day	1	2	3	4	5	6	7	8	9
Cackling Canada Goose	25	0.77	**2**	**5**	**8**	**10**	**13**	**15**	**18**	**22**	**24**
Emperor Goose	24	0.77	1.9	4.8	7.7	9.6	12.5	14.4	17.3	21.1	23.0
White-fronted Goose	25	0.77	2.0	5.0	8.0	10.0	13.0	15.0	18.0	22.0	24.0
Black Brant	23	0.80	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Tundra Swan	31	0.50	2.5	6.2	9.9	12.4	16.1	18.6	22.3	27.3	29.8
Sandhill Crane	30	0.50	2.4	6.0	9.6	12.0	15.6	18.0	21.6	26.4	28.8
Spectacled Eider	24	0.75	1.9	4.8	7.7	9.6	12.5	14.4	17.3	21.1	23.0
Common Eider	25	0.75	2.0	5.0	8.0	10.0	13.0	15.0	18.0	22.0	24.0
Loon (Pacific, red-throated)	27	0.50	2.2	5.4	8.6	10.8	14.0	16.2	19.4	23.8	25.9
Glaucous Gull	23	0.75	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Mew Gull	23	0.75	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Sabine's Gull	23	0.75	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Arctic Tern	23	0.75	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Long-tailed Duck	25	0.67	2.0	5.0	8.0	10.0	13.0	15.0	18.0	22.0	24.0
Dabbling Duck	23	1.00	1.8	4.6	7.4	9.2	12.0	13.8	16.6	20.2	22.1
Small Shorebirds	21	0.75	1.7	4.2	6.7	8.4	10.9	12.6	15.1	18.5	20.2

Table 2. Estimated 10-year average (2003-2012) population sizes and growth rates (90% CI) of nests and eggs on the YKD coastal zone (12,832 km^2). Nest and egg estimates are corrected for average nest detection rate. Growth rates significantly different from zero are indicated by bold italics font.

Species	Mean Nest Population	Nest Population Growth Rate (90% CI)	Mean Egg Population	Egg Population Growth Rate (90% CI)
Cackling Goose	120,142	***1.080 (1.054-1.107)***	442,696	***1.106 (1.058-1.156)***
Emperor Goose	40.252	***1.036 (1.012-1.062)***	180,113	***1.041 (1.008-1.076)***
White-fronted Goose	164,510	***1.080 (1.049-1.113)***	669,218	***1.074 (1.035-1.114)***
Black Brant	30,164	1.011 (0.935-1.092)	78,505	***1.119 (1.010-1.240)***
Tundra Swan	12,127	0.996 (0.967-1.026)	44,253	***0.899 (0.899-0.981)***
Sandhill Crane	17,342	1.004 (0.974-1.036)	31,076	0.986 (0.955-1.018)
Spectacled Eider	5,381	***1.058 (1.005-1.113)***	21,581	***1.081 (1.023-1.142)***
Common Eider	3,317	1.055 (0.925-1.203)	14,107	1.065 (0.926-1.224)
Glaucous Gull	16,238	0.924 (0.850-1.003)	38,343	0.959 (0.881-1.044)
Mew Gull	12,932	0.992 (0.908-1.083)	30,453	1.002 (0.918-1.095)
Sabine's Gull	13,893	***1.110 (1.028-1.199)***	30,061	***1.133 (1.023-1.254)***
Arctic Tern	15,616	1.051 (0.996-1.109)	26,534	1.042 (0.984-1.103)
Red-throated Loon	4,631	0.960 (0.899-1.026)	7,252	0.969 (0.901-1.043)
Pacific Loon	31,980	***1.049 (1.010-1.090)***	50,240	***1.059 (1.008-1.112)***

Table 3. Estimated 28-year average (1985-2012) population sizes and growth rates (90% CI) of nests and eggs on the YKD coastal zone (12,832 km^2). Nest and egg estimates are corrected for average nest detection rate. Growth rates significantly different from zero are indicated by bold italics font.

Species	Mean Nest Population	Nest Population Growth Rate (90% CI)	Mean Egg Population	Egg Population Growth Rate (90% CI)
Cackling Goose	91,972	***1.053 (1.043-1.064)***	334,302	***1.059 (1.043-1.075)***
Emperor Goose	37,210	***1.011 (1.000-1.022)***	167,189	1.013 (0.999-1.027)
White-fronted Goose	102,209	***1.092 (1.078-1.106)***	420,165	***1.092 (1.075-1.109)***
Black Brant	37,040	0.994 (0.974-1.014)	97,814	1.002 (0.975-1.030)
Tundra Swan	10,404	***1.019 (1.011-1.027)***	38,077	***1.014 (1.003-1.026)***
Sandhill Crane	16,864	***1.013 (1.000-1.026)***	28,739	***1.018 (1.003-1.034)***
Spectacled Eider	4,901	0.999 (0.986-1.012)	19,204	1.007 (0.991-1.023)
Common Eider	2,089	***1.075 (1.050-1.101)***	8,787	***1.081 (1.051-1.111)***
Glaucous Gull	15,348	1.003 (0.987-1.020)	35,469	1.013 (0.995-1.030)
Mew Gull	11,096	1.003 (0.979-1.027)	25,952	1.010 (0.985-1.034)
Sabine's Gull	10,334	***1.072 (1.049-1.095)***	22,989	***1.058 (1.036-1.082)***
Arctic Tern	11,854	***1.072 (1.045-1.100)***	21,600	***1.070 (1.040-1.100)***
Red-throated Loon	4,902	0.987 (0.969-1.006)	7,887	0.985 (0.967-1.003)
Pacific Loon	32,141	1.009 (0.993-1.025)	51,683	1.006 (0.990-1.023)

Table 4. Estimated nest initiation and hatch date based on egg float angles (1982-2012). Means calculated using nest as sample unit. Years with fewer than 3 nests per species not included in calculations. 90% confidence interval of 1982-2012 mean is based on standard deviation of annual point estimates.

Cackling Goose

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	5-Jun	9.3	4-Jul	6.8	170
1983	25-May	9.5	24-Jun	8.2	428
1984	29-May	9.4	27-Jun	8.5	328
1985	4-Jun	8.0	2-Jul	6.3	278
1986	31-May	8.1	30-Jun	6.3	347
1987	30-May	8.0	28-Jun	6.3	209
1988	26-May	10.7	24-Jun	9.0	88
1989	1-Jun	8.1	1-Jul	6.5	55
1990	25-May	7.8	24-Jun	6.9	195
1991	24-May	7.7	22-Jun	6.5	356
1992	1-Jun	7.1	1-Jul	6.0	397
1993	26-May	7.1	24-Jun	6.0	358
1994	21-May	7.8	19-Jun	6.5	409
1995	22-May	7.0	20-Jun	6.2	725
1996	20-May	7.7	18-Jun	6.7	755
1997	19-May	7.3	17-Jun	6.7	812
1998	27-May	6.1	25-Jun	5.2	889
1999	29-May	7.3	27-Jun	6.4	772
2000	27-May	6.8	25-Jun	6.0	1014
2001	31-May	6.3	28-Jun	5.8	522
2002	22-May	6.4	21-Jun	5.3	930
2003	19-May	9.1	17-Jun	7.9	562
2004	16-May	7.9	14-Jun	7.1	964
2005	22-May	8.4	20-Jun	7.4	957
2006	29-May	6.4	27-Jun	5.3	845
2007	21-May	7.1	19-Jun	6.2	1027
2008	25-May	6.1	23-Jun	5.2	906
2009	27-May	6.4	25-Jun	5.6	1374
2010	23-May	6.5	21-Jun	5.7	773
2011	25-May	6.7	23-Jun	5.8	902
2012	2-Jun	6.3	1-Jul	5.6	519
Mean	26-May	1.5	24-Jun	1.5	

Emperor Goose

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	5-Jun	8.2	4-Jul	6.4	71
1983	22-May	9.3	20-Jun	7.7	177
1984	26-May	10.3	24-Jun	8.2	161
1985	2-Jun	7.6	1-Jul	5.7	107
1986	29-May	7.4	27-Jun	5.6	197
1987	30-May	7.3	27-Jun	5.5	142
1988	24-May	8.9	22-Jun	6.8	102
1989	1-Jun	8.1	30-Jun	6.0	63
1990	23-May	8.6	21-Jun	6.5	100
1991	22-May	7.2	20-Jun	6.0	263
1992	1-Jun	6.5	30-Jun	5.0	184
1993	24-May	7.2	21-Jun	5.9	139
1994	21-May	7.4	19-Jun	5.8	192
1995	21-May	7.4	18-Jun	6.0	188
1996	19-May	6.3	17-Jun	5.1	185
1997	18-May	7.5	15-Jun	5.8	153
1998	27-May	6.5	24-Jun	5.2	215
1999	30-May	6.5	27-Jun	5.6	188
2000	26-May	7.2	24-Jun	5.9	280
2001	29-May	7.5	27-Jun	5.4	104
2002	20-May	6.6	18-Jun	5.3	249
2003	18-May	8.6	15-Jun	6.8	153
2004	15-May	7.7	13-Jun	6.2	253
2005	19-May	9.4	17-Jun	7.2	303
2006	27-May	6.3	24-Jun	5.0	253
2007	21-May	7.0	19-Jun	5.4	275
2008	24-May	6.9	22-Jun	5.2	240
2009	26-May	6.5	24-Jun	5.1	349
2010	23-May	6.4	20-Jun	5.2	189
2011	24-May	6.6	21-Jun	5.0	206
2012	2-Jun	6.5	1-Jul	5.2	119
Mean	25-May	1.6	23-Jun	1.5	

Table 4. Estimated nest initiation and hatch date continued.

Black Brant

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	0.0	--	0.0	1
1983	24-May	9.1	19-Jun	6.7	448
1984	30-May	7.4	25-Jun	6.6	440
1985	1-Jun	4.8	27-Jun	6.0	29
1986	30-May	5.6	26-Jun	4.7	131
1987	1-Jun	5.2	25-Jun	3.5	172
1988	25-May	9.0	20-Jun	7.2	51
1989	1-Jun	6.4	27-Jun	5.6	40
1990	25-May	5.8	22-Jun	6.2	130
1991	24-May	6.6	19-Jun	6.0	183
1992	1-Jun	6.5	27-Jun	5.9	152
1993	26-May	6.0	21-Jun	5.5	107
1994	22-May	6.8	17-Jun	5.9	93
1995	23-May	7.7	18-Jun	6.7	41
1996	23-May	6.4	18-Jun	4.9	44
1997	20-May	7.6	14-Jun	7.0	100
1998	28-May	6.5	23-Jun	5.5	260
1999	31-May	7.2	26-Jun	6.6	108
2000	29-May	6.3	24-Jun	5.7	216
2001	1-Jun	6.2	26-Jun	5.5	77
2002	24-May	7.5	19-Jun	6.6	163
2003	22-May	8.2	16-Jun	7.5	56
2004	18-May	8.5	12-Jun	7.9	101
2005	23-May	6.9	17-Jun	6.6	148
2006	29-May	6.5	24-Jun	5.7	123
2007	22-May	7.1	17-Jun	6.1	147
2008	27-May	5.9	21-Jun	5.3	103
2009	29-May	7.7	24-Jun	6.7	202
2010	25-May	7.9	20-Jun	7.0	134
2011	25-May	6.2	20-Jun	5.6	50
2012	3-Jun	5.7	30-Jun	5.3	37
Mean	26-May	1.3	21-Jun	1.3	

White-fronted Geese

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	6-Jun	7.0	4-Jul	6.4	14
1983	22-May	7.5	20-Jun	7.1	172
1984	24-May	10.3	22-Jun	8.7	84
1985	31-May	6.6	30-Jun	4.7	42
1986	28-May	7.4	26-Jun	6.6	102
1987	28-May	6.5	26-Jun	5.2	61
1988	26-May	9.0	23-Jun	7.3	32
1989	30-May	8.1	28-Jun	6.2	21
1990	24-May	7.2	22-Jun	6.4	52
1991	23-May	7.9	21-Jun	6.7	138
1992	1-Jun	6.8	30-Jun	5.6	115
1993	26-May	6.3	24-Jun	5.7	84
1994	21-May	8.0	19-Jun	5.9	129
1995	23-May	8.0	21-Jun	6.8	178
1996	21-May	8.6	19-Jun	7.5	144
1997	20-May	8.0	18-Jun	6.6	184
1998	28-May	6.7	25-Jun	5.5	261
1999	30-May	7.6	27-Jun	6.7	208
2000	28-May	8.2	26-Jun	6.6	334
2001	31-May	6.9	28-Jun	5.8	311
2002	24-May	6.3	22-Jun	5.0	306
2003	21-May	8.7	19-Jun	7.4	272
2004	17-May	8.0	16-Jun	6.5	364
2005	23-May	8.0	20-Jun	6.9	438
2006	28-May	7.2	26-Jun	5.9	370
2007	21-May	7.6	19-Jun	6.2	446
2008	25-May	6.8	23-Jun	5.6	327
2009	27-May	6.7	25-Jun	5.6	477
2010	23-May	7.3	21-Jun	6.0	353
2011	25-May	7.3	23-Jun	5.8	549
2012	1-Jun	7.3	30-Jun	5.6	155
Mean	26-May	1.3	24-Jun	1.3	

Table 4. Estimated nest initiation and hatch date continued.

Tundra Swan

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	2-Jun	10.1	5-Jul	9.6	11
1983	19-May	6.3	24-Jun	6.5	11
1984	23-May	10.2	26-Jun	9.7	9
1985	31-May	8.0	4-Jul	7.0	14
1986	25-May	8.7	28-Jun	8.6	24
1987	27-May	7.1	30-Jun	6.5	12
1988	23-May	11.9	26-Jun	10.6	5
1989	27-May	3.2	2-Jul	2.7	4
1990	22-May	4.1	24-Jun	3.6	4
1991	21-May	9.8	25-Jun	9.5	12
1992	29-May	9.0	1-Jul	8.8	9
1993	22-May	7.4	26-Jun	7.7	6
1994	18-May	8.7	22-Jun	7.5	9
1995	23-May	4.6	26-Jun	4.7	9
1996	17-May	8.4	20-Jun	9.3	9
1997	18-May	7.6	21-Jun	5.8	13
1998	28-May	8.4	1-Jul	7.7	20
1999	29-May	7.1	1-Jul	7.1	14
2000	24-May	8.4	27-Jun	7.6	22
2001	28-May	9.2	1-Jul	9.0	16
2002	22-May	5.2	26-Jun	4.9	10
2003	13-May	7.2	18-Jun	6.5	21
2004	14-May	8.1	20-Jun	7.7	16
2005	21-May	7.9	23-Jun	6.8	18
2006	29-May	6.0	1-Jul	6.9	14
2007	21-May	7.2	24-Jun	6.7	19
2008	26-May	6.2	29-Jun	5.3	19
2009	29-May	7.7	2-Jul	6.6	19
2010	23-May	8.3	27-Jun	8.5	14
2011	24-May	7.6	28-Jun	6.9	20
2012	3-Jun	5.3	7-Jul	4.9	6
Mean	24-May	1.3	27-Jun	1.5	

Sandhill Crane

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	24-May	2.0	24-Jun	2.0	4
1983	23-May	11.9	22-Jun	11.5	21
1984	19-May	4.5	20-Jun	8.5	9
1985	30-May	7.0	30-Jun	6.6	13
1986	27-May	8.8	26-Jun	9.3	26
1987	25-May	8.6	24-Jun	8.4	16
1988	20-May	4.4	20-Jun	4.4	6
1989	19-May	3.3	19-Jun	3.3	2
1990	19-May	4.4	18-Jun	4.5	9
1991	16-May	7.1	16-Jun	7.0	25
1992	30-May	5.2	30-Jun	5.2	11
1993	19-May	4.6	19-Jun	4.8	14
1994	14-May	2.1	14-Jun	2.6	5
1995	18-May	9.0	17-Jun	8.7	10
1996	15-May	5.9	15-Jun	5.8	14
1997	15-May	7.3	14-Jun	7.2	8
1998	21-May	4.5	20-Jun	4.5	19
1999	23-May	4.9	23-Jun	4.5	12
2000	20-May	7.1	20-Jun	7.0	22
2001	21-May	2.5	20-Jun	1.9	7
2002	19-May	10.5	19-Jun	10.5	12
2003	13-May	9.6	13-Jun	9.6	13
2004	16-May	6.8	16-Jun	6.5	10
2005	15-May	6.4	15-Jun	6.4	23
2006	23-May	8.9	23-Jun	8.5	19
2007	12-May	7.8	12-Jun	7.8	16
2008	21-May	4.3	21-Jun	4.2	12
2009	23-May	8.8	23-Jun	8.9	20
2010	18-May	5.3	18-Jun	5.5	17
2011	20-May	9.8	20-Jun	9.4	14
2012	26-May	10.7	27-Jun	10.3	7
Mean	20-May	1.3	20-Jun	1.4	

Table 4. Estimated nest initiation and hatch date continued.

Spectacled Eider

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	13-Jun	9.4	8-Jul	5.2	18
1983	28-May	12.3	24-Jun	11.6	35
1984	6-Jun	9.1	30-Jun	8.8	9
1985	7-Jun	9.0	4-Jul	7.6	20
1986	8-Jun	10.7	3-Jul	9.0	38
1987	31-May	8.2	28-Jun	7.4	28
1988	30-May	6.8	27-Jun	7.0	19
1989	4-Jun	10.6	2-Jul	9.0	5
1990	26-May	5.4	23-Jun	4.9	15
1991	24-May	10.1	22-Jun	9.3	25
1992	4-Jun	7.5	3-Jul	6.0	18
1993	28-May	7.1	24-Jun	7.3	18
1994	27-May	13.0	23-Jun	11.2	15
1995	26-May	8.0	24-Jun	7.3	44
1996	22-May	7.1	19-Jun	6.9	33
1997	23-May	8.1	19-Jun	7.2	39
1998	31-May	8.6	28-Jun	7.4	52
1999	31-May	10.3	28-Jun	9.7	51
2000	31-May	8.2	29-Jun	8.0	52
2001	6-Jun	8.8	3-Jul	6.7	32
2002	24-May	7.4	22-Jun	6.5	59
2003	26-May	11.0	22-Jun	10.1	36
2004	19-May	10.3	16-Jun	9.3	57
2005	24-May	9.2	20-Jun	8.7	101
2006	1-Jun	9.4	29-Jun	8.5	78
2007	26-May	8.8	23-Jun	8.0	68
2008	27-May	10.2	24-Jun	9.3	73
2009	30-May	9.2	26-Jun	8.3	124
2010	24-May	7.5	21-Jun	6.8	71
2011	28-May	10.1	25-Jun	9.0	50
2012	3-Jun	7.5	2-Jul	6.9	47
Mean	30-May	1.5	26-Jun	1.7	

Common Eider

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	11-Jun	3.0	9-Jul	1.4	4
1983	29-May	5.6	26-Jun	6.2	3
1984	--	--	--	--	0
1985	--	--	--	--	0
1986	--	--	--	--	0
1987	1-Jun	5.3	29-Jun	5.7	10
1988	--	--	--	--	1
1989	2-Jun	7.4	2-Jul	6.1	4
1990	23-May	3.3	22-Jun	2.1	3
1991	28-May	5.9	26-Jun	5.7	27
1992	4-Jun	6.2	3-Jul	5.3	12
1993	25-May	5.4	24-Jun	5.2	5
1994	26-May	10.1	24-Jun	9.2	9
1995	25-May	11.2	23-Jun	10.7	13
1996	22-May	11.1	20-Jun	10.5	14
1997	22-May	9.4	19-Jun	8.0	15
1998	30-May	6.8	28-Jun	6.2	18
1999	2-Jun	9.5	30-Jun	9.8	12
2000	1-Jun	5.8	30-Jun	4.9	23
2001	2-Jun	7.6	30-Jun	7.0	23
2002	25-May	7.7	24-Jun	6.8	17
2003	25-May	12.1	22-Jun	10.8	16
2004	21-May	9.5	18-Jun	8.7	18
2005	21-May	8.4	19-Jun	8.2	34
2006	2-Jun	7.7	1-Jul	6.8	52
2007	22-May	7.2	21-Jun	6.9	50
2008	27-May	7.4	25-Jun	6.8	34
2009	28-May	5.7	26-Jun	5.5	33
2010	26-May	5.7	24-Jun	5.4	41
2011	25-May	7.6	23-Jun	6.4	10
2012	2-Jun	4.1	2-Jul	4.0	7
Mean	28-May	1.6	26-Jun	1.6	

Table 4. Estimated nest initiation and hatch date continued.

Pacific Loon, Red-throated Loon

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	13-Jun	7.7	8-Jul	3.7	25
1983	2-Jun	11.7	29-Jun	9.9	16
1984	5-Jun	6.3	3-Jul	6.3	5
1985	12-Jun	10.9	7-Jul	6.7	15
1986	8-Jun	9.3	5-Jul	6.2	38
1987	5-Jun	6.5	3-Jul	5.9	35
1988	31-May	11.2	28-Jun	11.7	5
1989	5-Jun	12.3	2-Jul	10.4	5
1990	3-Jun	6.8	1-Jul	6.6	11
1991	30-May	7.1	26-Jun	6.9	21
1992	9-Jun	7.0	6-Jul	4.8	15
1993	28-May	6.9	25-Jun	6.6	12
1994	27-May	6.0	24-Jun	5.7	6
1995	29-May	5.7	26-Jun	5.4	10
1996	27-May	7.2	23-Jun	7.3	9
1997	25-May	6.6	22-Jun	6.5	17
1998	3-Jun	8.5	30-Jun	8.0	37
1999	5-Jun	8.6	3-Jul	8.1	48
2000	3-Jun	7.8	1-Jul	7.7	40
2001	6-Jun	8.4	4-Jul	7.2	27
2002	29-May	6.2	26-Jun	5.9	42
2003	27-May	8.9	24-Jun	9.0	14
2004	27-May	9.7	24-Jun	9.4	10
2005	30-May	10.3	27-Jun	10.0	42
2006	5-Jun	4.1	2-Jul	4.0	22
2007	27-May	7.1	24-Jun	7.3	31
2008	1-Jun	8.5	29-Jun	8.1	46
2009	4-Jun	8.4	1-Jul	7.9	35
2010	31-May	6.4	28-Jun	6.2	28
2011	1-Jun	7.6	29-Jun	7.4	29
2012	5-Jun	9.7	4-Jul	9.1	7
Mean	2-Jun	1.3	29-Jun	1.4	

Glaucous Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	11-Jun	8.0	5-Jul	6.2	23
1983	28-May	10.4	21-Jun	9.9	19
1984	30-May	4.8	25-Jun	9.7	8
1985	8-Jun	6.1	3-Jul	6.3	23
1986	2-Jun	8.0	27-Jun	7.4	19
1987	3-Jun	8.4	28-Jun	8.1	19
1988	29-May	8.9	23-Jun	9.1	9
1989	28-May	0.0	22-Jun	0.0	3
1990	24-May	2.5	19-Jun	4.1	3
1991	24-May	7.2	18-Jun	7.3	26
1992	3-Jun	5.9	27-Jun	5.6	24
1993	26-May	9.9	20-Jun	9.4	11
1994	23-May	7.5	17-Jun	7.0	17
1995	24-May	4.2	17-Jun	4.4	17
1996	22-May	4.3	15-Jun	4.2	15
1997	23-May	8.8	17-Jun	8.2	19
1998	28-May	7.5	22-Jun	7.2	64
1999	2-Jun	9.5	26-Jun	9.1	25
2000	29-May	8.8	23-Jun	8.6	72
2001	31-May	7.9	24-Jun	7.9	50
2002	23-May	7.7	17-Jun	7.4	56
2003	20-May	7.8	13-Jun	7.4	58
2004	17-May	7.2	11-Jun	7.0	21
2005	20-May	8.0	14-Jun	7.7	69
2006	31-May	8.6	25-Jun	8.3	46
2007	22-May	7.2	15-Jun	7.1	76
2008	27-May	7.2	21-Jun	6.8	67
2009	29-May	7.7	23-Jun	7.6	59
2010	27-May	9.1	20-Jun	8.5	28
2011	27-May	9.1	21-Jun	8.5	23
2012	4-Jun	11.0	29-Jun	9.9	8
Mean	28-May	1.7	21-Jun	1.7	

Table 4. Estimated nest initiation and hatch date continued.

Mew Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	17-Jun	4.6	10-Jul	1.9	11
1983	30-May	11.3	23-Jun	11.0	9
1984	--	--	--	--	2
1985	11-Jun	7.2	4-Jul	6.4	8
1986	7-Jun	13.0	2-Jul	10.6	18
1987	2-Jun	8.5	26-Jun	7.4	8
1988	25-May	7.1	19-Jun	6.5	4
1989	--	--	--	--	1
1990	28-May	7.4	22-Jun	7.4	2
1991	26-May	7.6	20-Jun	8.1	8
1992	4-Jun	5.1	28-Jun	4.9	10
1993	31-May	9.3	24-Jun	8.9	7
1994	21-May	6.4	15-Jun	6.1	8
1995	24-May	3.3	18-Jun	3.5	16
1996	21-May	6.0	15-Jun	5.5	10
1997	25-May	5.7	19-Jun	5.7	8
1998	30-May	7.0	24-Jun	6.5	19
1999	1-Jun	9.1	25-Jun	8.8	25
2000	2-Jun	8.4	26-Jun	8.0	17
2001	2-Jun	8.7	27-Jun	8.2	18
2002	22-May	8.3	16-Jun	8.0	40
2003	23-May	8.3	17-Jun	8.1	20
2004	21-May	4.4	14-Jun	3.9	19
2005	26-May	8.9	19-Jun	8.5	32
2006	2-Jun	9.3	26-Jun	9.1	45
2007	24-May	8.3	18-Jun	7.8	32
2008	27-May	7.2	20-Jun	6.9	42
2009	30-May	7.4	24-Jun	7.2	54
2010	26-May	5.4	20-Jun	5.1	44
2011	30-May	7.9	23-Jun	8.1	18
2012	4-Jun	5.8	29-Jun	4.9	13
Mean	29-May	1.9	23-Jun	2.0	

Sabine's Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	1
1983	28-May	11.9	21-Jun	13.0	3
1984	--	--	--	--	0
1985	9-Jun	12.7	2-Jul	9.7	3
1986	31-May	11.2	24-Jun	10.1	7
1987	28-May	10.1	21-Jun	9.1	7
1988	1-Jun	9.6	25-Jun	9.1	8
1989	7-Jun	16.5	1-Jul	15.6	2
1990	--	--	--	--	0
1991	22-May	5.5	15-Jun	5.9	9
1992	--	--	--	--	0
1993	24-May	5.8	17-Jun	5.6	8
1994	18-May	6.6	11-Jun	5.4	6
1995	25-May	9.8	18-Jun	8.6	6
1996	18-May	5.4	12-Jun	4.7	3
1997	21-May	6.7	14-Jun	6.9	8
1998	28-May	10.1	21-Jun	9.4	11
1999	27-May	7.2	20-Jun	7.4	20
2000	30-May	9.8	23-Jun	9.8	7
2001	3-Jun	6.6	27-Jun	6.4	10
2002	21-May	8.4	14-Jun	8.2	28
2003	19-May	7.7	12-Jun	7.5	5
2004	17-May	13.2	10-Jun	12.0	3
2005	23-May	9.7	16-Jun	9.3	30
2006	28-May	3.9	22-Jun	3.7	23
2007	24-May	8.9	17-Jun	8.2	30
2008	25-May	7.0	18-Jun	6.7	17
2009	29-May	10.0	22-Jun	9.6	17
2010	22-May	3.0	15-Jun	2.6	20
2011	24-May	3.8	17-Jun	4.0	40
2012	1-Jun	5.2	26-Jun	4.8	14
Mean	26-May	1.8	19-Jun	1.9	

Table 4. Estimated nest initiation and hatch date continued.

Arctic Tern

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	0
1983	--	--	--	--	0
1984	--	--	--	--	0
1985	6-Jun	6.1	29-Jun	5.7	8
1986	3-Jun	14.7	26-Jun	13.7	6
1987	1-Jun	4.7	24-Jun	4.7	3
1988	2-Jun	0.8	25-Jun	0.0	2
1989	--	--	--	--	1
1990	--	--	--	--	1
1991	24-May	4.8	17-Jun	4.8	4
1992	8-Jun	8.6	2-Jul	8.1	6
1993	23-May	2.8	17-Jun	3.9	3
1994	--	--	--	--	1
1995	23-May	4.7	16-Jun	5.1	3
1996	--	--	--	--	1
1997	--	--	--	--	0
1998	3-Jun	10.5	26-Jun	10.0	5
1999	2-Jun	5.2	26-Jun	5.1	8
2000	3-Jun	4.8	26-Jun	4.8	5
2001	29-May	7.7	22-Jun	8.2	5
2002	25-May	6.2	18-Jun	5.8	37
2003	21-May	7.8	13-Jun	7.2	5
2004	25-May	11.5	17-Jun	10.9	9
2005	28-May	8.1	21-Jun	7.7	15
2006	30-May	5.9	23-Jun	5.7	17
2007	23-May	7.5	16-Jun	7.3	18
2008	28-May	7.9	21-Jun	7.5	16
2009	2-Jun	7.5	26-Jun	7.4	30
2010	30-May	8.8	22-Jun	8.5	9
2011	31-May	9.6	24-Jun	9.4	19
2012	3-Jun	7.4	28-Jun	7.0	14
Mean	30-May	1.7	22-Jun	1.7	

Greater Scaup, Long-tailed Duck

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	18-Jun	5.8	10-Jul	0.0	5
1983	--	--	--	--	1
1984	--	--	--	--	1
1985	--	--	--	--	1
1986	7-Jun	5.9	9-Jul	3.4	4
1987	6-Jun	6.7	7-Jul	5.4	4
1988	--	--	--	--	1
1989	--	--	--	--	1
1990	8-Jun	4.9	7-Jul	1.6	2
1991	26-May	6.6	28-Jun	7.4	2
1992	7-Jun	6.3	8-Jul	5.4	21
1993	2-Jun	5.7	2-Jul	3.3	18
1994	2-Jun	3.8	2-Jul	1.4	7
1995	3-Jun	7.9	3-Jul	8.7	14
1996	31-May	11.7	29-Jun	9.3	7
1997	27-May	10.4	27-Jun	10.0	10
1998	2-Jun	7.5	4-Jul	6.4	14
1999	8-Jun	8.0	8-Jul	3.9	10
2000	5-Jun	5.5	7-Jul	5.2	26
2001	11-Jun	8.1	7-Jul	4.0	6
2002	31-May	6.0	1-Jul	2.3	8
2003	30-May	3.6	30-Jun	1.3	3
2004	22-May	8.2	21-Jun	3.3	2
2005	1-Jun	9.4	1-Jul	7.1	9
2006	3-Jun	6.4	5-Jul	5.2	5
2007	2-Jun	5.0	2-Jul	2.5	5
2008	--	--	--	--	1
2009	3-Jun	9.5	3-Jul	8.1	7
2010	29-May	10.0	29-Jun	10.9	6
2011	29-May	5.8	1-Jul	5.3	4
2012	8-Jun	2.5	9-Jul	0.8	2
Mean	3-Jun	1.5	3-Jul	1.8	

Table 4. Estimated nest initiation and hatch date continued.

Pintail, Mallard, Shoveler, Teal

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	1
1983	--	--	--	--	1
1984	10-Jun	3.3	8-Jul	5.8	2
1985	13-Jun	6.6	8-Jul	3.3	2
1986	6-Jun	11.6	4-Jul	9.0	13
1987	6-Jun	13.2	3-Jul	10.5	12
1988	3-Jun	4.9	2-Jul	4.1	2
1989	9-Jun	6.4	6-Jul	4.3	4
1990	1-Jun	7.8	28-Jun	5.6	4
1991	27-May	11.1	24-Jun	10.7	13
1992	7-Jun	10.9	5-Jul	8.0	18
1993	1-Jun	6.1	28-Jun	2.7	16
1994	31-May	5.8	28-Jun	2.4	5
1995	1-Jun	14.9	27-Jun	11.5	11
1996	28-May	13.2	26-Jun	11.4	10
1997	20-May	7.6	17-Jun	4.7	4
1998	4-Jun	8.2	1-Jul	6.9	39
1999	3-Jun	10.2	2-Jul	8.2	17
2000	3-Jun	7.9	1-Jul	6.3	28
2001	5-Jun	4.2	2-Jul	3.7	13
2002	28-May	13.8	24-Jun	9.8	21
2003	22-May	10.0	20-Jun	10.0	8
2004	21-May	12.4	19-Jun	10.8	19
2005	27-May	12.3	23-Jun	10.3	24
2006	4-Jun	9.1	1-Jul	7.9	15
2007	25-May	8.7	22-Jun	7.0	17
2008	30-May	11.1	27-Jun	8.5	21
2009	31-May	8.5	28-Jun	6.9	16
2010	27-May	8.5	24-Jun	6.6	18
2011	28-May	7.4	26-Jun	4.9	6
2012	4-Jun	6.7	3-Jul	5.6	4
Mean	1-Jun	1.7	28-Jun	1.8	

Shorebirds

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	1
1983	--	--	--	--	0
1984	--	--	--	--	3
1985	13-Jun	12.9	3-Jul	11.6	4
1986	1-Jun	13.3	27-Jun	9.6	23
1987	28-May	5.9	21-Jun	4.7	7
1988	24-May	1.6	18-Jun	1.6	2
1989	1-Jun	12.8	24-Jun	11.7	3
1990	1-Jun	7.4	26-Jun	7.4	2
1991	28-May	12.2	22-Jun	11.9	21
1992	3-Jun	4.0	28-Jun	4.2	11
1993	27-May	7.1	21-Jun	6.9	15
1994	25-May	9.9	19-Jun	9.0	2
1995	26-May	7.6	19-Jun	7.6	6
1996	27-May	13.7	20-Jun	13.9	10
1997	19-May	3.6	12-Jun	3.4	3
1998	29-May	8.3	22-Jun	7.3	8
1999	31-May	7.0	25-Jun	6.9	17
2000	30-May	7.2	24-Jun	6.4	13
2001	2-Jun	8.3	27-Jun	8.1	22
2002	25-May	5.7	19-Jun	5.8	21
2003	21-May	2.8	15-Jun	2.8	3
2004	20-May	5.9	13-Jun	6.1	10
2005	26-May	7.3	20-Jun	6.7	30
2006	2-Jun	9.0	26-Jun	8.1	29
2007	24-May	7.5	18-Jun	7.2	33
2008	26-May	8.3	20-Jun	7.8	53
2009	1-Jun	8.2	26-Jun	8.0	23
2010	27-May	9.2	21-Jun	8.9	29
2011	25-May	5.9	19-Jun	5.8	26
2012	3-Jun	8.8	29-Jun	8.1	27
Mean	28-May	1.5	22-Jun	1.6	

Table 5. Numbers and proportions of plots with fox sign (observed fox, scat, fur, tracks, and/or active dens) and vole sign (observed voles, digging, runways), 1988-2012.

Year	Number Plots Sampled	Number Plots with Fox Sign	Number Plots with Vole Sign	Proportion of Plots with Fox Sign	Proportion of Plots with Vole Sign
1988	26	15	10	0.58	0.38
1989	20	8	8	0.40	0.40
1990	30	13	16	0.43	0.53
1991	33	7	12	0.21	0.36
1992	41	15	9	0.37	0.22
1993	45	7	8	0.16	0.18
1994	38	6	4	0.16	0.11
1995	48	21	14	0.44	0.29
1996	44	20	15	0.45	0.34
1997	72	25	18	0.35	0.25
1998	62	21	21	0.34	0.34
1999	53	24	20	0.45	0.38
2000	79	24	62	0.30	0.78
2001	80	71	31	0.89	0.39
2002	84	50	19	0.60	0.23
2003	83	69	44	0.83	0.53
2004	81	53	16	0.65	0.20
2005	83	46	10	0.55	0.12
2006	74	44	11	0.59	0.15
2007	79	26	26	0.33	0.33
2008	82	58	33	0.71	0.40
2009	81	33	58	0.41	0.72
2010	66	28	38	0.42	0.58
2011	82	45	11	0.55	0.13
2012	77	33	10	0.43	0.13
Mean	62	30	21	0.46	0.34